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Olson et al.

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(54) **PAYMENT CARD AND METHODS**

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(73) Assignee: **Stratos Technologies, Inc.**, Ann Arbor, MI (US)

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G06K 19/06	(2006.01)
G06Q 20/34	(2012.01)
G07F 7/08	(2006.01)

(52) **U.S. Cl.**

CPC ***G06K 19/06206*** (2013.01); ***G06Q 20/341*** (2013.01); ***G06Q 20/3415*** (2013.01); ***G06Q 20/3572*** (2013.01); ***G07F 7/0833*** (2013.01); ***G07F 7/0853*** (2013.01)

(58) **Field of Classification Search**

USPC 235/487, 488, 492; 340/10.1, 340/572.01–572.22

See application file for complete search history.

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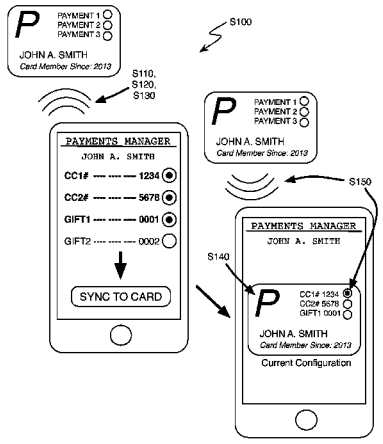
(57) **ABSTRACT**

One variation of a payment card includes: a sheet comprising first and second icons; a transducer configured to output a voltage in response to an impulse on the sheet; a wireless communication module; a first input region adjacent the first icon; a second input region adjacent the second icon; a magnetic stripe emulator; and a processor configured to transition from a passive state to an active state in response a voltage output from the transducer, to receive a first magnetic sequence command associated with a first payment method and a second magnetic sequence command associated with a second payment method, to assign the first payment method to the first input region and the second payment method to the second input region, to receive a selection for the second payment method from the second input region, and to control the magnetic stripe emulator according to the second magnetic sequence command.

20 Claims, 13 Drawing Sheets



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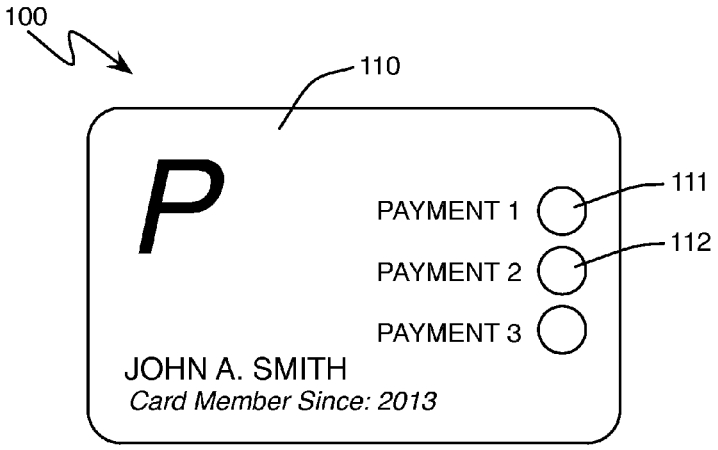

FIG. 1

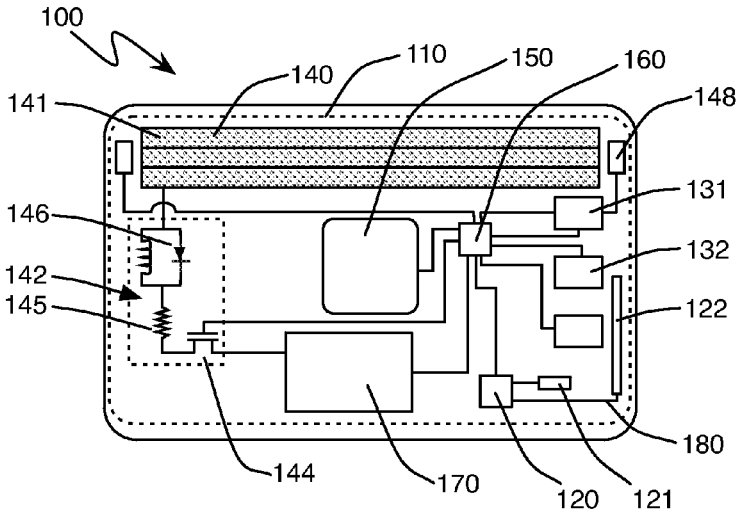

FIG. 2A

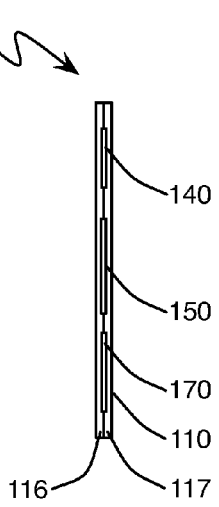

FIG. 2B

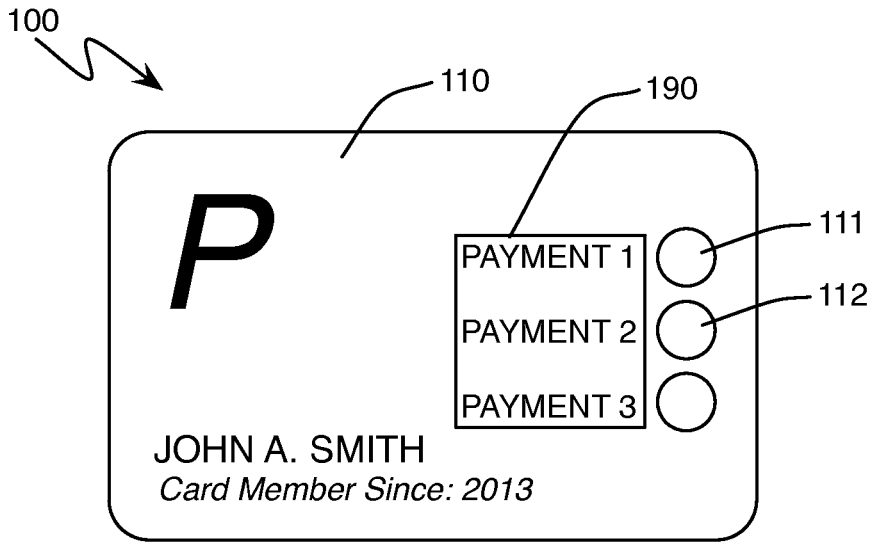
100
110
190
P
PAYMENT 1
PAYMENT 2
PAYMENT 3
111
112
JOHN A. SMITH
Card Member Since: 2013

FIG. 3

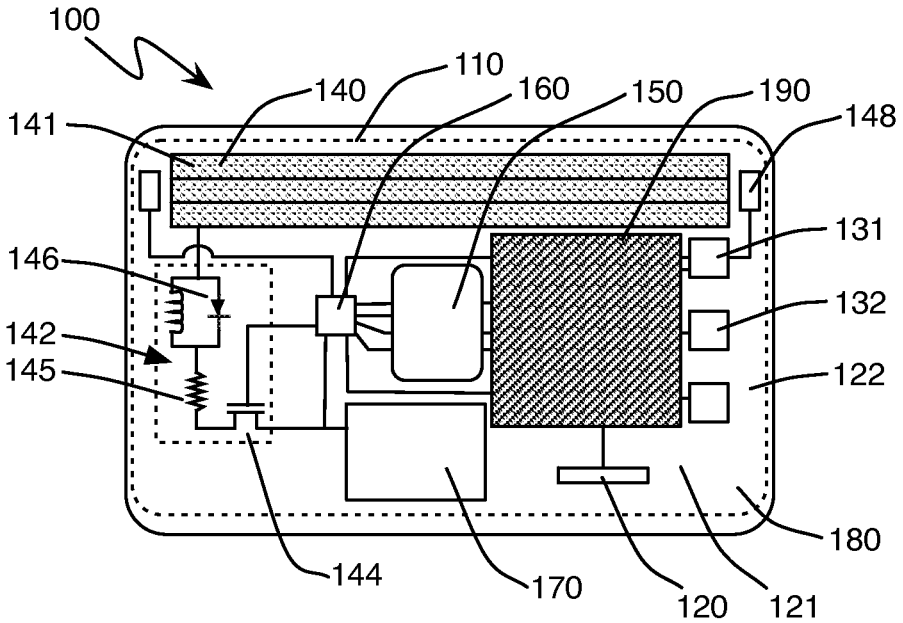
100
110
140
160
150
190
148
141
131
146
132
142
145
122
180
144
170
120
121

FIG. 4

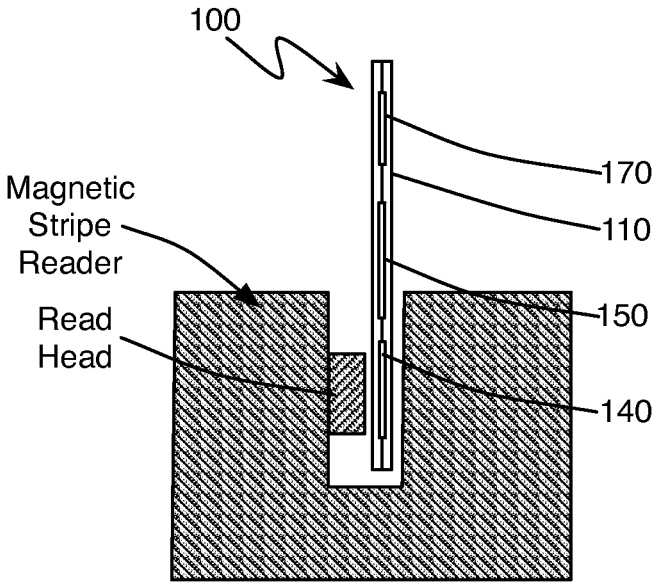

FIG. 5

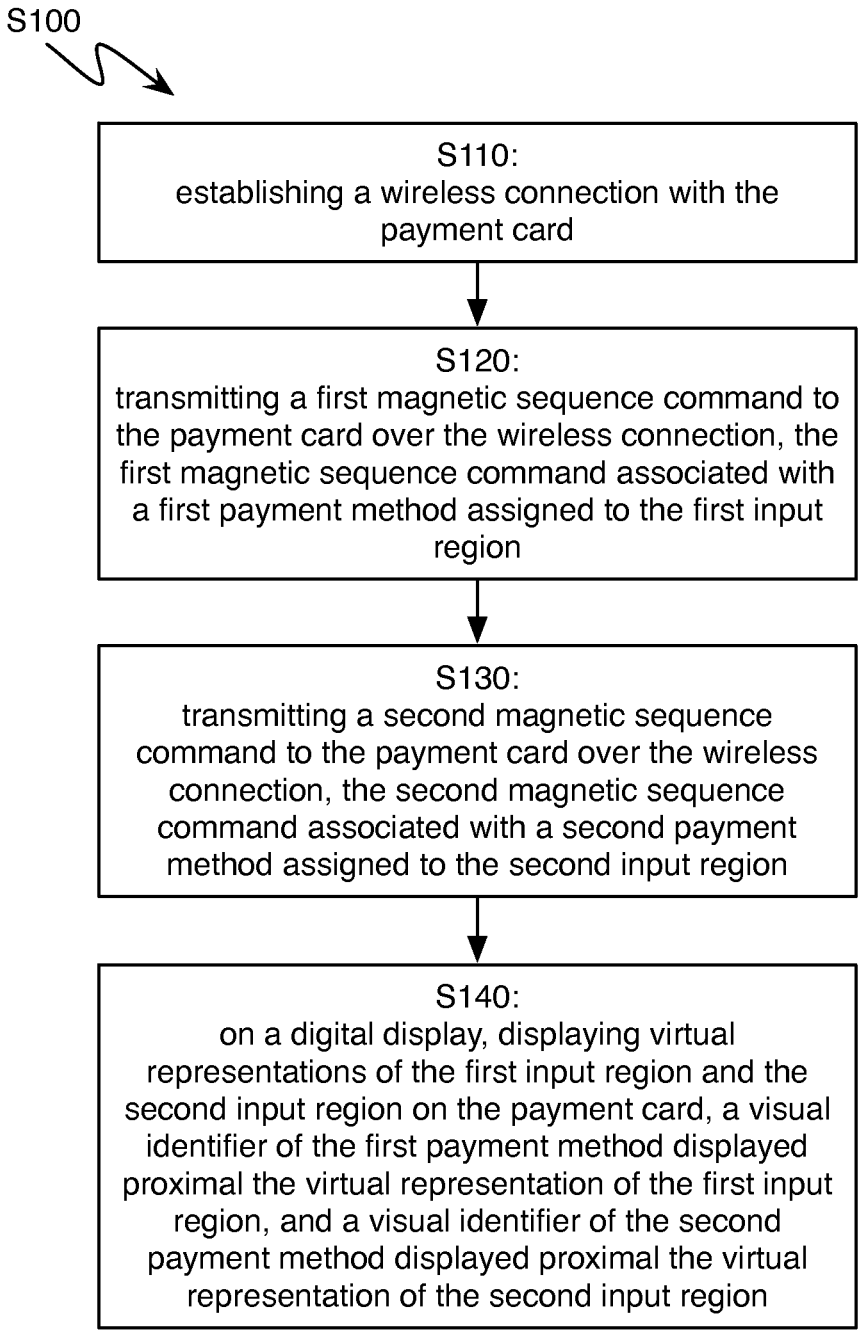
S100
S110:
establishing a wireless connection with the payment card
S120:
transmitting a first magnetic sequence command to the payment card over the wireless connection, the first magnetic sequence command associated with a first payment method assigned to the first input region
S130:
transmitting a second magnetic sequence command to the payment card over the wireless connection, the second magnetic sequence command associated with a second payment method assigned to the second input region
S140:
on a digital display, displaying virtual representations of the first input region and the second input region on the payment card, a visual identifier of the first payment method displayed proximal the virtual representation of the first input region, and a visual identifier of the second payment method displayed proximal the virtual representation of the second input region

FIG. 6

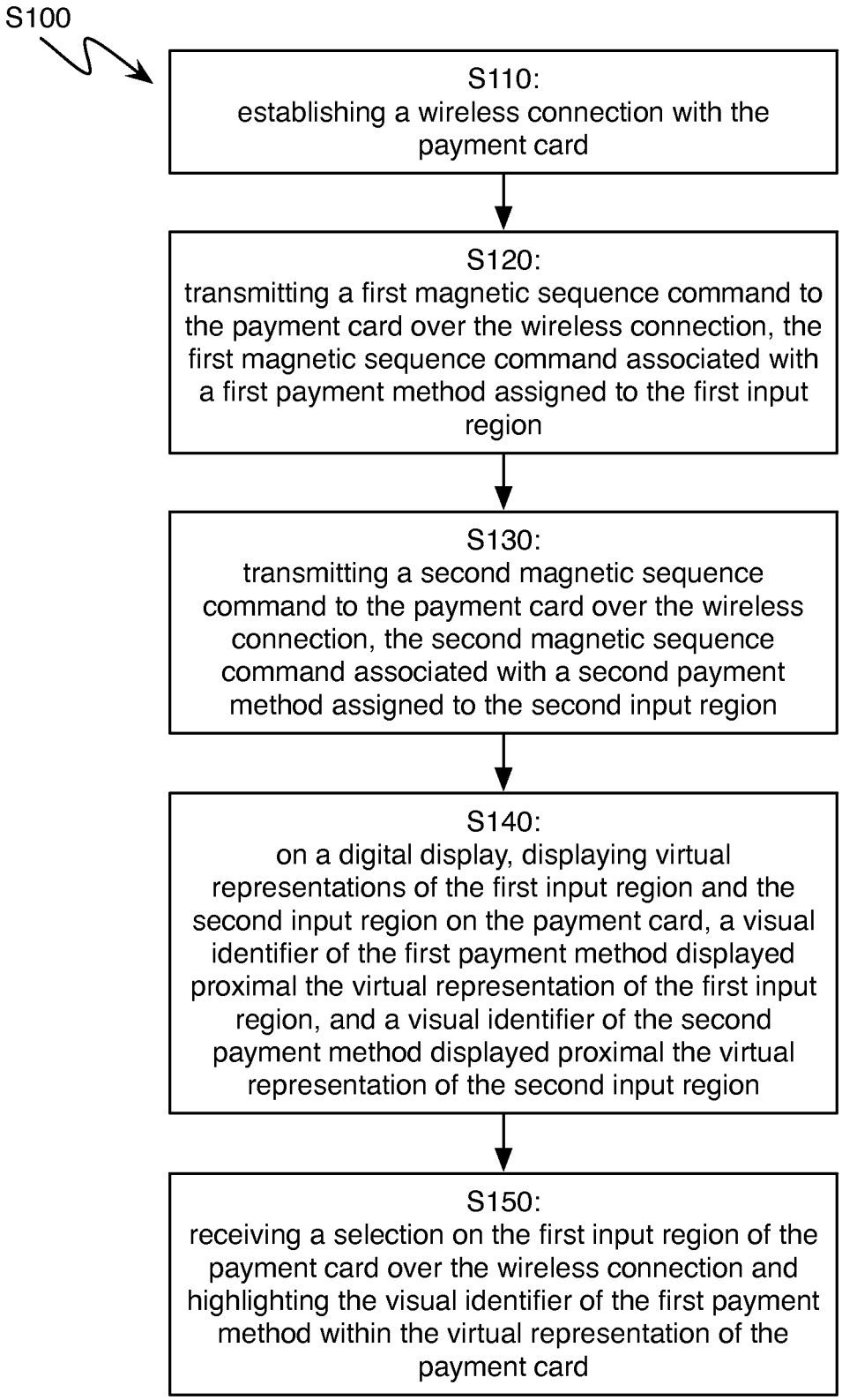
S100
S110:
establishing a wireless connection with the payment card
S120:
transmitting a first magnetic sequence command to the payment card over the wireless connection, the first magnetic sequence command associated with a first payment method assigned to the first input region
S130:
transmitting a second magnetic sequence command to the payment card over the wireless connection, the second magnetic sequence command associated with a second payment method assigned to the second input region
S140:
on a digital display, displaying virtual representations of the first input region and the second input region on the payment card, a visual identifier of the first payment method displayed proximal the virtual representation of the first input region, and a visual identifier of the second payment method displayed proximal the virtual representation of the second input region
S150:
receiving a selection on the first input region of the payment card over the wireless connection and highlighting the visual identifier of the first payment method within the virtual representation of the payment card

FIG. 7

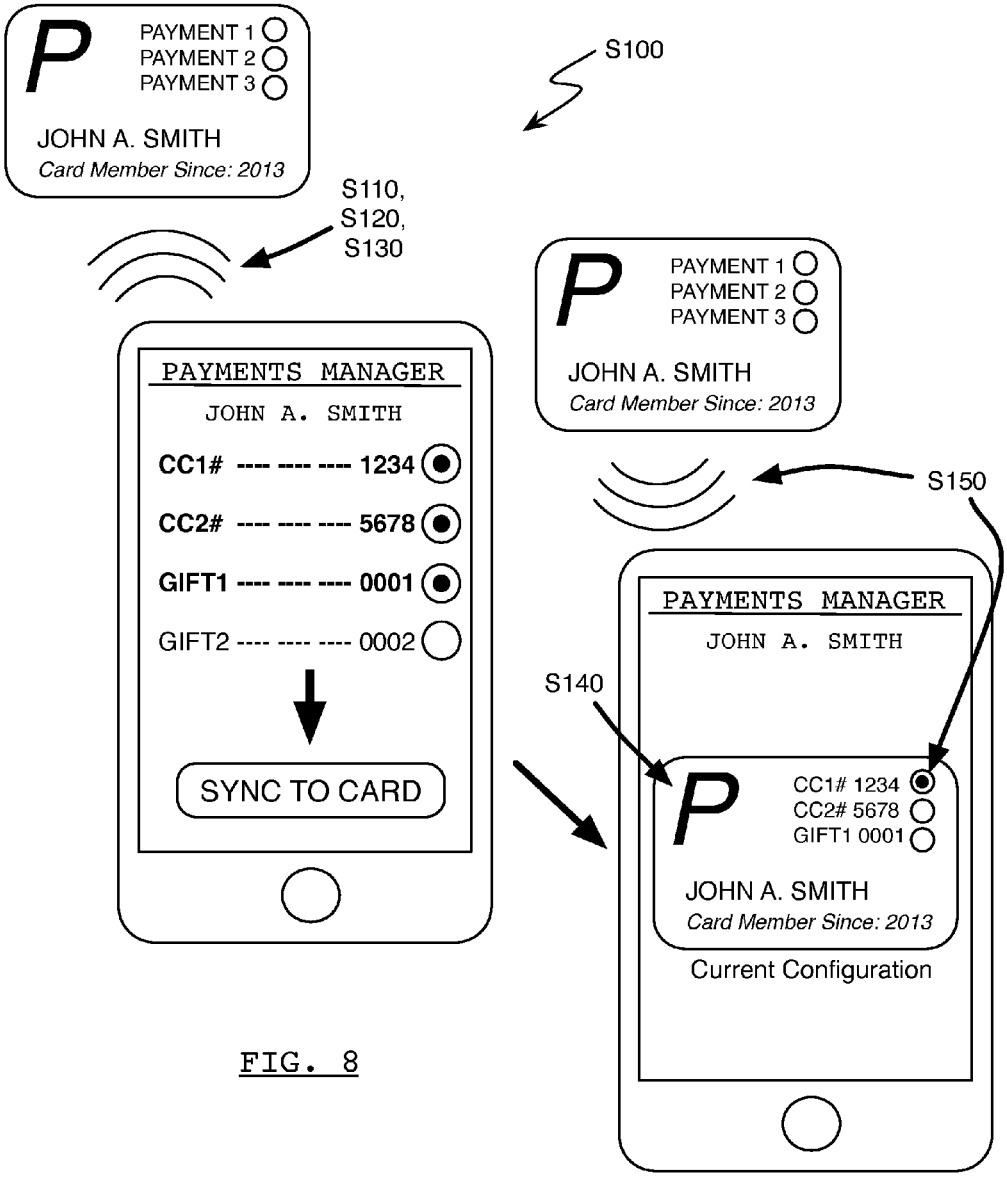
P
PAYMENT 1
PAYMENT 2
PAYMENT 3
JOHN A. SMITH
Card Member Since: 2013
S100
S110,
S120,
S130
PAYMENTS MANAGER
JOHN A. SMITH
CC1# ---- ---- ---- 1234
CC2# ---- ---- ---- 5678
GIFT1 ---- ---- ---- 0001
GIFT2 ---- ---- ---- 0002
SYNC TO CARD
P
PAYMENT 1
PAYMENT 2
PAYMENT 3
JOHN A. SMITH
Card Member Since: 2013
S150
PAYMENTS MANAGER
JOHN A. SMITH
S140
P
CC1# 1234
CC2# 5678
GIFT1 0001
JOHN A. SMITH
Card Member Since: 2013
Current Configuration

FIG. 8

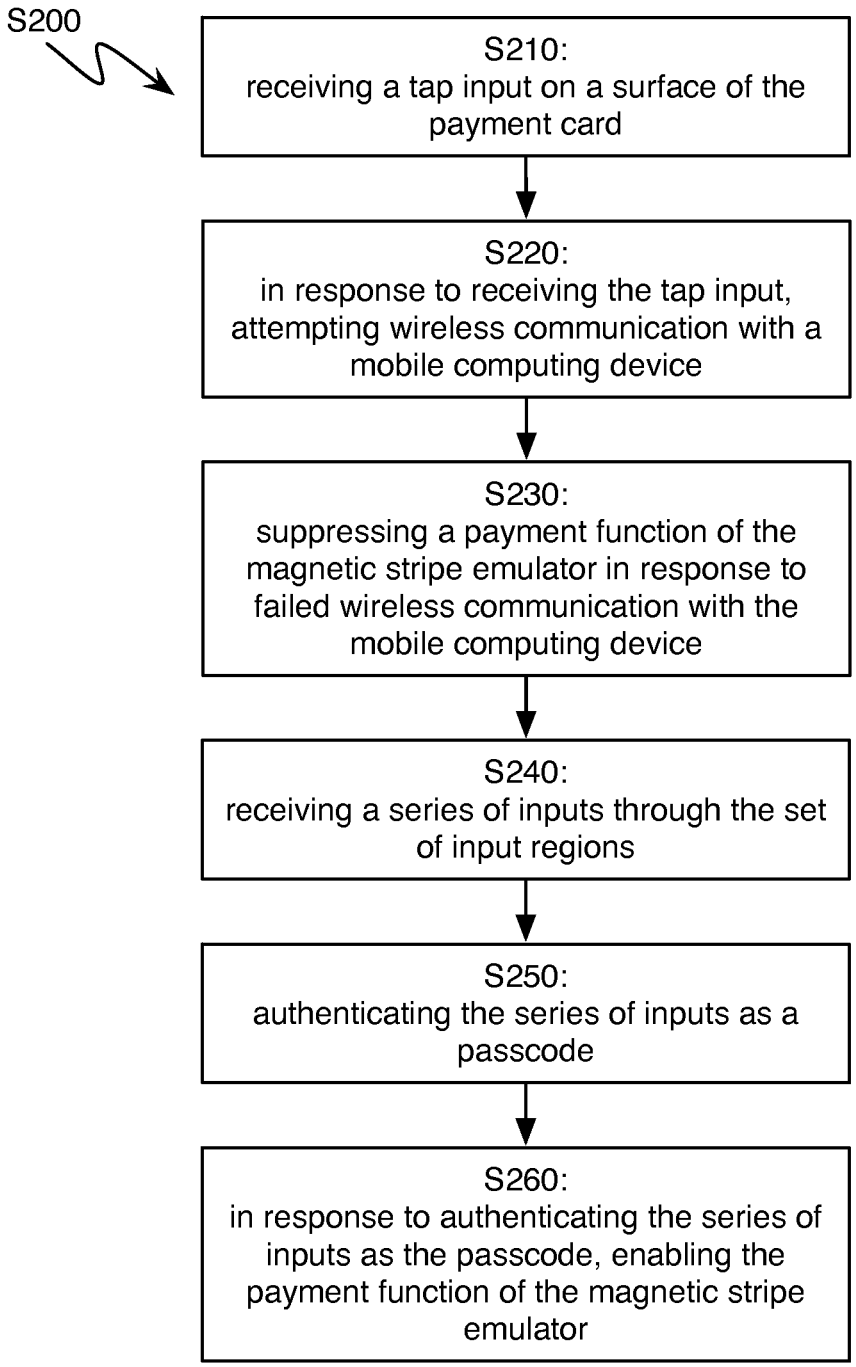
S200
S210:
receiving a tap input on a surface of the payment card
S220:
in response to receiving the tap input, attempting wireless communication with a mobile computing device
S230:
suppressing a payment function of the magnetic stripe emulator in response to failed wireless communication with the mobile computing device
S240:
receiving a series of inputs through the set of input regions
S250:
authenticating the series of inputs as a passcode
S260:
in response to authenticating the series of inputs as the passcode, enabling the payment function of the magnetic stripe emulator

FIG. 9

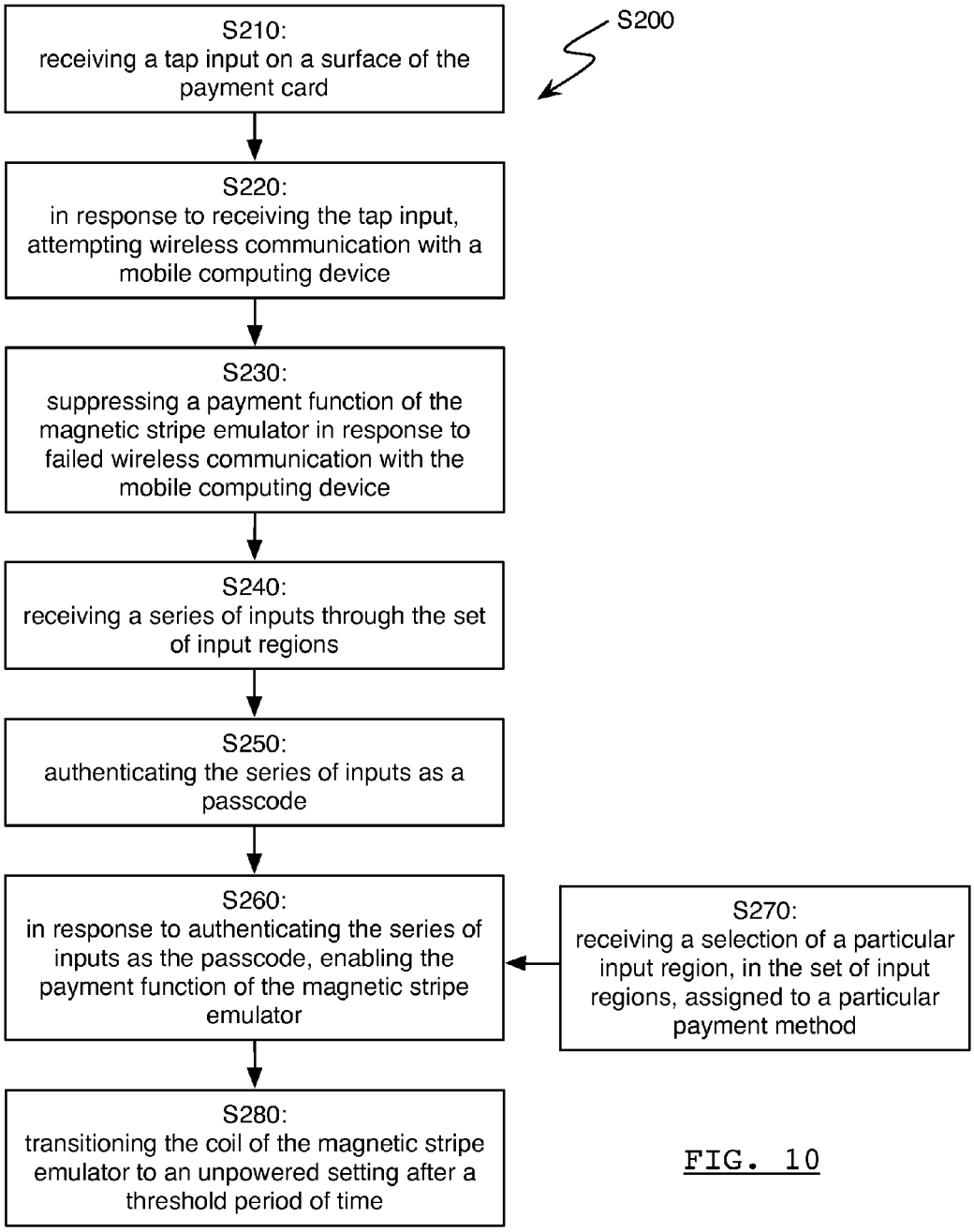
S200
S210:
receiving a tap input on a surface of the payment card
S220:
in response to receiving the tap input, attempting wireless communication with a mobile computing device
S230:
suppressing a payment function of the magnetic stripe emulator in response to failed wireless communication with the mobile computing device
S240:
receiving a series of inputs through the set of input regions
S250:
authenticating the series of inputs as a passcode
S260:
in response to authenticating the series of inputs as the passcode, enabling the payment function of the magnetic stripe emulator
S270:
receiving a selection of a particular input region, in the set of input regions, assigned to a particular payment method
S280:
transitioning the coil of the magnetic stripe emulator to an unpowered setting after a threshold period of time

FIG. 10

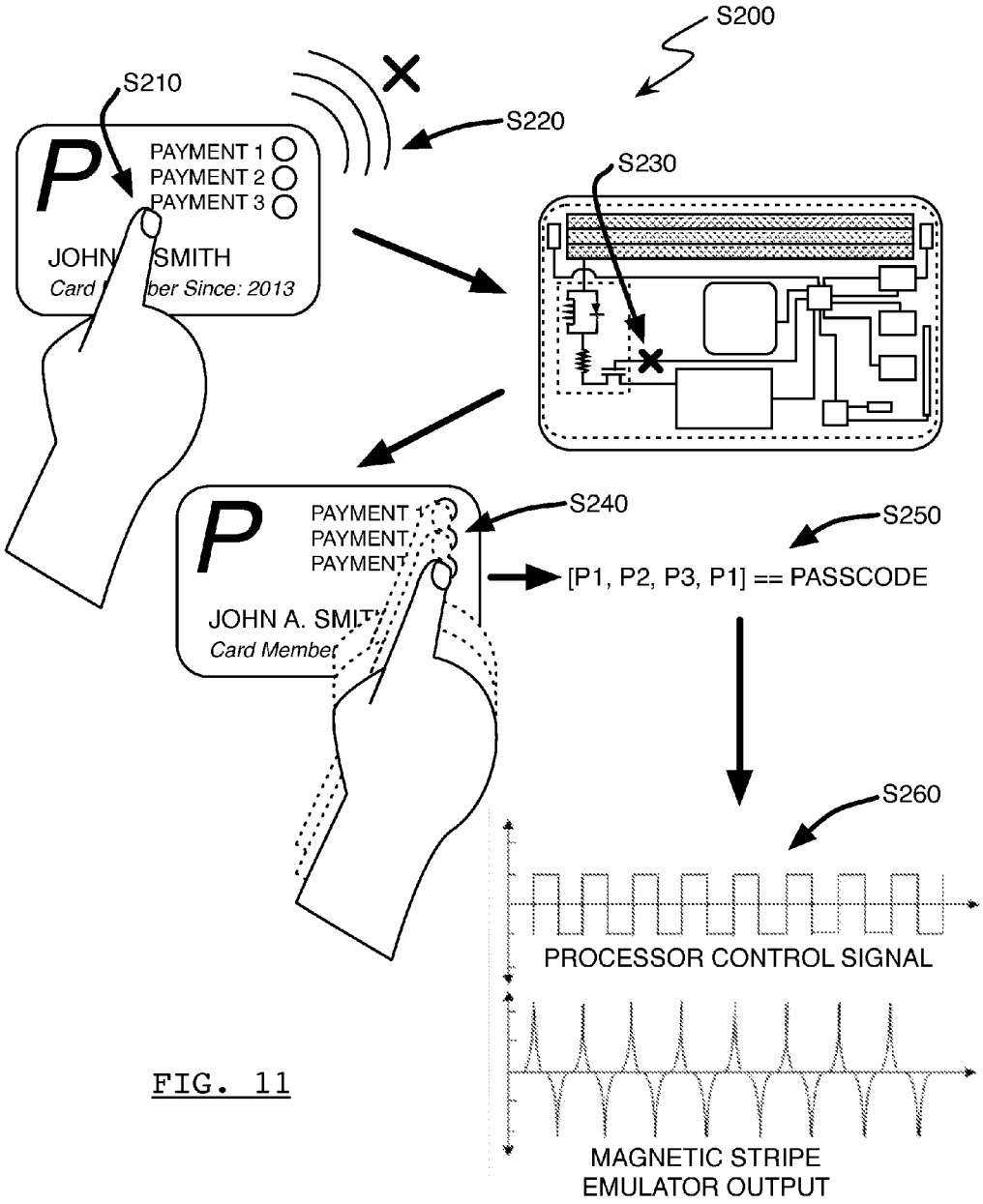
S200
S210
S220
S230
PAYMENT 1
PAYMENT 2
PAYMENT 3
JOHN SMITH
Card Member Since: 2013
S240
S250
[P1, P2, P3, P1] == PASSCODE
JOHN A. SMITH
Card Member
S260
PROCESSOR CONTROL SIGNAL
MAGNETIC STRIPE
EMULATOR OUTPUT

FIG. 11

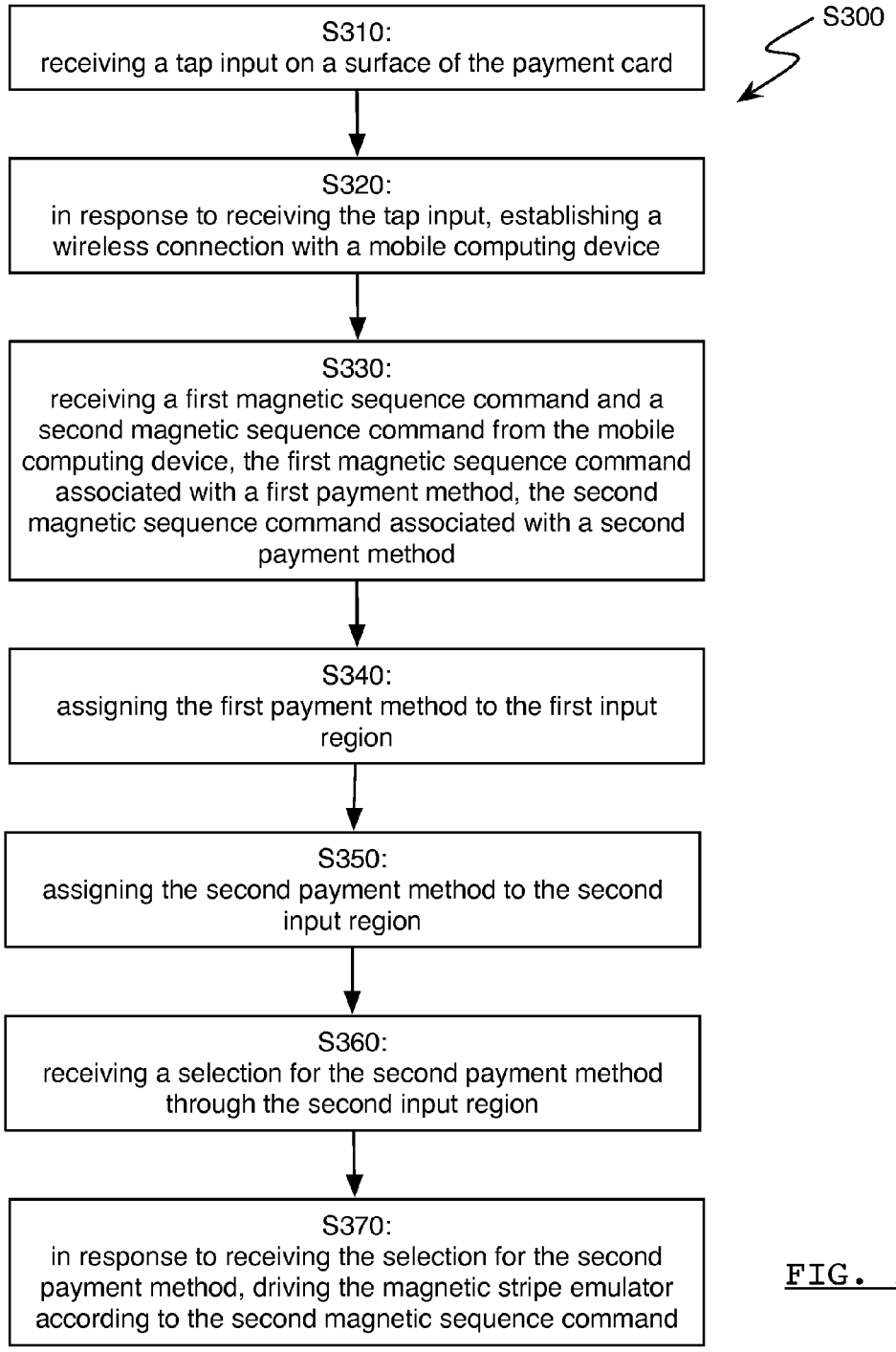
S300
S310:
receiving a tap input on a surface of the payment card
S320:
in response to receiving the tap input, establishing a wireless connection with a mobile computing device
S330:
receiving a first magnetic sequence command and a second magnetic sequence command from the mobile computing device, the first magnetic sequence command associated with a first payment method, the second magnetic sequence command associated with a second payment method
S340:
assigning the first payment method to the first input region
S350:
assigning the second payment method to the second input region
S360:
receiving a selection for the second payment method through the second input region
S370:
in response to receiving the selection for the second payment method, driving the magnetic stripe emulator according to the second magnetic sequence command

FIG. 12

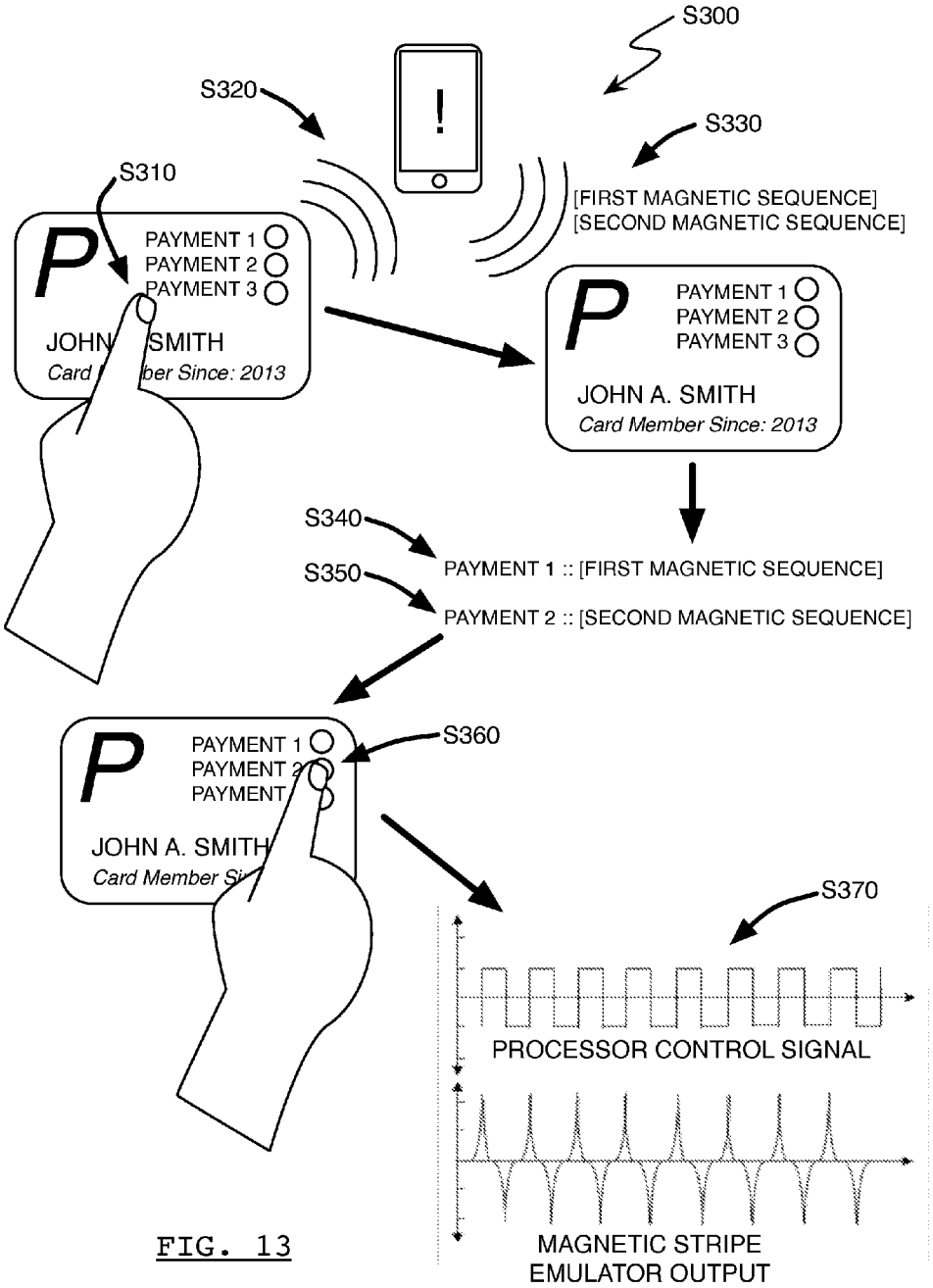
S300
S320
S330
S310
[FIRST MAGNETIC SEQUENCE]
[SECOND MAGNETIC SEQUENCE]
PAYMENT 1
PAYMENT 2
PAYMENT 3
JOHN A. SMITH
Card Member Since: 2013
S340
S350
PAYMENT 1 :: [FIRST MAGNETIC SEQUENCE]
PAYMENT 2 :: [SECOND MAGNETIC SEQUENCE]
S360
S370
PROCESSOR CONTROL SIGNAL
MAGNETIC STRIPE
EMULATOR OUTPUT

FIG. 13

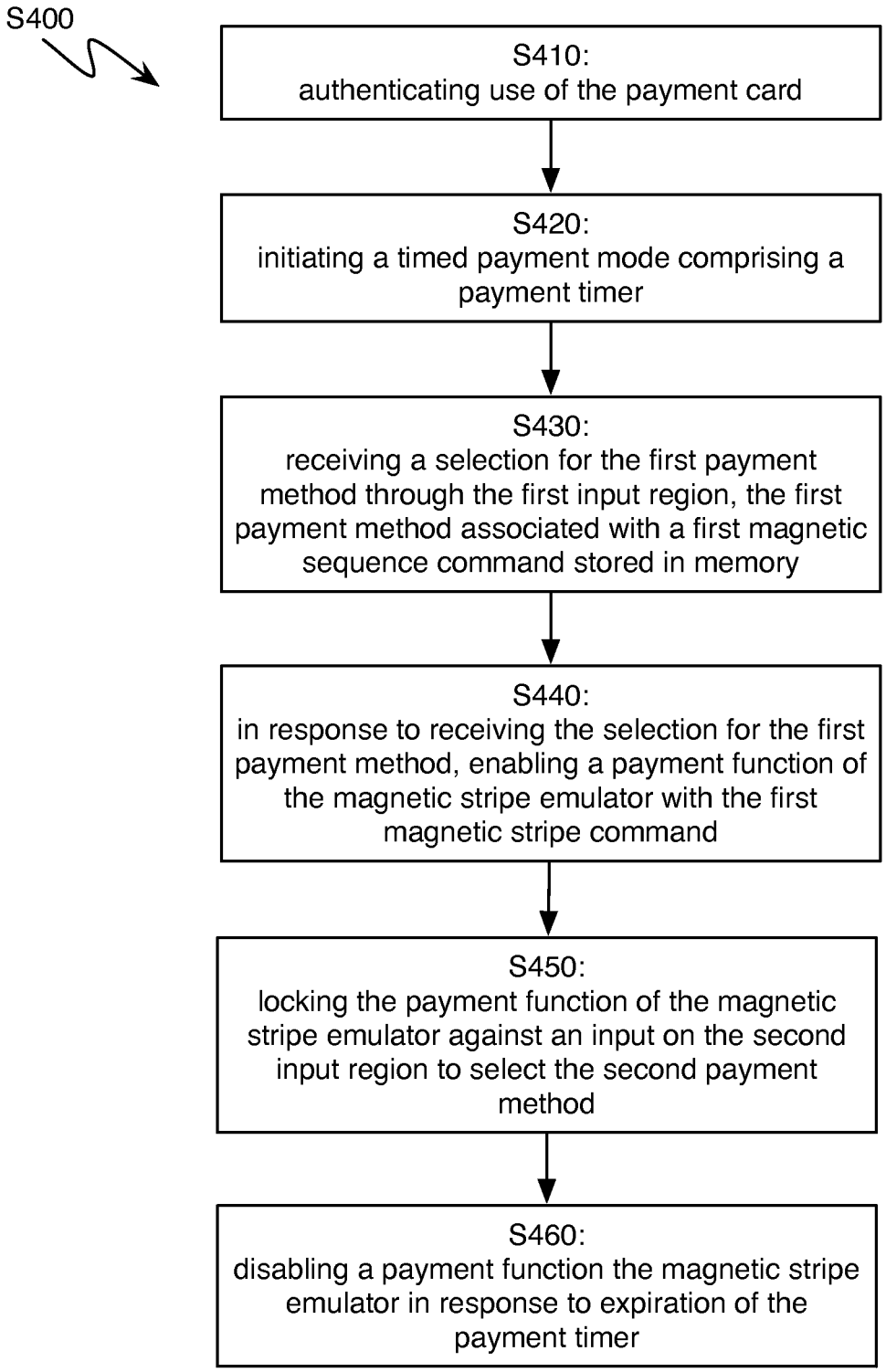
S400
S410:
authenticating use of the payment card
S420:
initiating a timed payment mode comprising a payment timer
S430:
receiving a selection for the first payment method through the first input region, the first payment method associated with a first magnetic sequence command stored in memory
S440:
in response to receiving the selection for the first payment method, enabling a payment function of the magnetic stripe emulator with the first magnetic stripe command
S450:
locking the payment function of the magnetic stripe emulator against an input on the second input region to select the second payment method
S460:
disabling a payment function the magnetic stripe emulator in response to expiration of the payment timer

FIG. 14

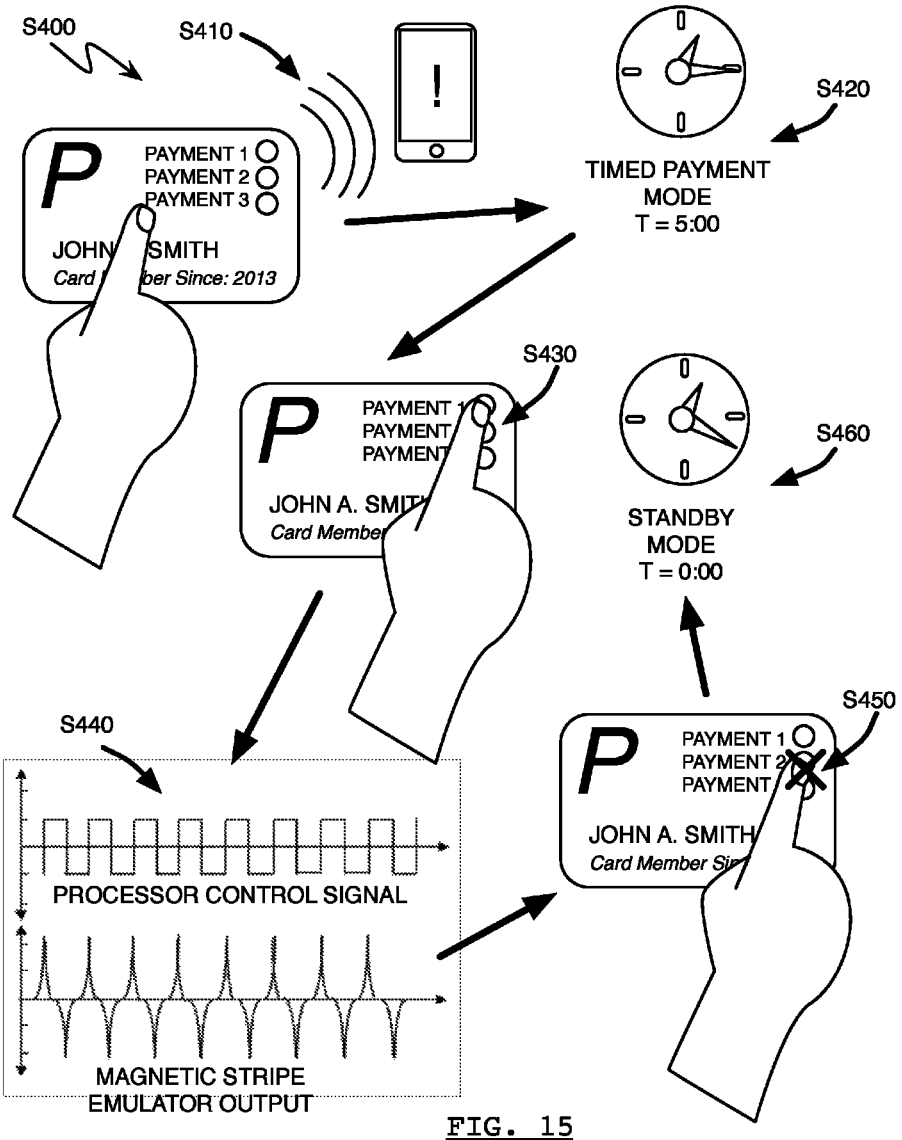
S400
S410
S420
TIMED PAYMENT
MODE
T = 5:00
PAYMENT 1
PAYMENT 2
PAYMENT 3
JOHN SMITH
S430
JOHN A. SMITH
S460
STANDBY
MODE
T = 0:00
S440
PROCESSOR CONTROL SIGNAL
MAGNETIC STRIPE
EMULATOR OUTPUT
S450
JOHN A. SMITH

FIG. 15

PAYMENT CARD AND METHODS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of co-pending U.S. patent application Ser. No. 13/904,951, filed 29 May 2013, which claims the benefit of U.S. Provisional Application No. 61/689,083 filed on 29 May 2012, U.S. Provisional Application No. 61/796,594, filed on 15 Nov. 2012, U.S. Provisional Application No. 61/848,581 filed on 7 Jan. 2013, U.S. Provisional Application No. 61/849,213 filed on 22 Jan. 2013, U.S. Provisional Application No. 61/850,866, filed on 25 Feb. 2013, and U.S. Provisional Application No. 61/818,831, filed on 2 May 2013, all of which are incorporated herein in their entireties by this reference.

TECHNICAL FIELD

This invention relates generally to the field of bank cards and, more specifically, to a new and useful payment card and associated methods in the field of bank cards.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a schematic representation of a payment card;

FIGS. **2**A and **2**B are schematic representations of the payment card;

FIG. **3** is a schematic representation of a variation of the payment card;

FIG. **4** is a schematic representation of a variation of the payment card;

FIG. **5** is a schematic representation of a variation of the payment card and a magnetic stripe reader;

FIG. **6** is a flowchart representation of a first method;

FIG. **7** is a flowchart representation of a variation of the first method;

FIG. **8** is a flowchart representation of a variation of the first method;

FIG. **9** is a flowchart representation of a second method;

FIG. **10** is a flowchart representation of a variation of the second method;

FIG. **11** is a flowchart representation of a variation of the second method;

FIG. **12** is a flowchart representation of a third method;

FIG. **13** is a flowchart representation of a variation of the third method;

FIG. **14** is a flowchart representation of a fourth method; and

FIG. **15** is a flowchart representation of a variation of the fourth method.

DESCRIPTION OF THE EMBODIMENTS

The following description of the embodiments of the invention is not intended to limit the invention to these embodiments, but rather to enable any person skilled in the art to make and use this invention.

1. Payment Card

As shown in FIGS. **1** and **2**A, a payment card includes: a sheet **110** comprising a first icon **111** and a second icon **112**; a transducer **150** arranged within the sheet **110** and configured to output a voltage in response to an impulse on a surface of the sheet no; a wireless communication module **120**; a first input region **131** adjacent the first icon **111**; a second input region **132** adjacent the second icon **112**; a magnetic stripe emulator **140**; and a processor **160** arranged within the sheet no and configured to transition from a passive state to an active state in response to receiving a voltage output from the transducer **150**, to receive a first magnetic sequence command associated with a first payment method and a second magnetic sequence command associated with a second payment method through the wireless communication module **120**, to assign the first payment method to the first input region **131** and the second payment method to the second input region **132**, to receive a selection for the second payment method from the second input region **132** in response to an input adjacent the second icon **112**, and to control the magnetic stripe emulator **140** according to the second magnetic sequence command in response to receiving the selection for the second payment method.

Generally, the payment card **100** functions to consolidate multiple plastic payment cards into a single physical card that can imitate payment functionalities of the multiple plastic payment cards through manipulation of a magnetic stripe emulator. For example, the payment card **100** can imitate a user's debit card issued through a bank, a user's primary credit card issued by a preferred credit card company, and a user's secondary credit card issued by another credit card company by selectively driving the magnetic stripe emulator **140** according to a unique magnetic sequence command associated with each individual card. The payment card **100** can additionally or alternatively imitate a gift card, an identification (i.e., ID) card (e.g., a driver's license), a loyalty card, a door or gate access card, or any other individual card containing data in a magnetic stripe. The payment card **100** can define a form factor substantially similar to that of a standard plastic payment card, that is, 3.370" (85.60 mm) wide by 2.125" (53.98 mm) tall by 0.06" thick.

The payment card **100** can also interface with a mobile computing device, via the wireless communication module **120**, to authenticate an upcoming payment attempt, to download magnetic sequence commands of a subset of available payment methods, and/or to upload a current payment selection for display on the mobile computing device. For example, the mobile computing device can be a smartphone or tablet, and a native application executing on the smartphone or tablet can manage entry of new plastic bank cards, selection of magnetic sequence commands to upload to the payment card **100**, and authentication of upcoming payments. The payment card **100** can also include the set of input regions to enable a user to select a particular payment method to imitate, to enter a passcode to authenticate an upcoming payment attempt, and/or to select a particular operating mode of the payment card **100**, such as a timed payment mode (described below). Therefore, the payment card **100** can—separately or in conjunction with a native application executing on a mobile computing device—consolidate multiple plastic bank cards into a single dynamic payment card of a similar form factor, thereby substantially eliminating a need for a user to carry multiple (i.e., more than one) bank cards, gift cards, and/or identification cards, etc. at any given time.

The sheet **110** of the payment card **100** includes a first icon and a second icon. Generally, the sheet **110** functions as a housing for the various components of the payment card **100**, including the transducer **150**, the wireless communication module **120**, the input regions, the processor **160**, etc. The sheet **110** can therefore define the external dimensions of the payment card **100**, and the sheet **110** can therefore be of a form factor substantially similar to that of a standard plastic bank card. In one implementation, the sheet **110** includes a front layer **116** and a back layer **117** that sandwiches various components of the payment card **100**. For example, the transducer **150**, the wireless communication module **120**, the input

regions, the processor **160**, and a battery can be mounted or constructed on a flexible circuit board **180** (shown in FIG. **2**A) that is sandwiched between the front layer **116** and the back layer **117** to define an external geometry that is 3.370" (85.60 mm) wide by 2.125" (53.98 mm) tall by 0.06" thick. Alternatively, the flexible circuit board **180** can be reaction injection molded between (or inside) the front layer **116** and the back layer **117**, and a glass card layer can be laminated over the front layer. However, the sheet **10** can be assembled in any other suitable way. The sheet no can also define a fluid-tight or dustproof housing that can seal any of the foregoing components against contamination by fluid or particulate ingress.

The sheet **110** also defines the first icon **111** and the second icon **112** that are visually and/or tactilely distinguishable by a user. In one example, as in the foregoing implementation, the first icon **111** and the second icon **112** can be printed on the front layer **116**. In this example, the front layer **116** can be transparent or translucent, and the first and second icons can be printed on an interior surface of the front layer **116** to protect the first and second icons from wear. In another example, the first icon **111** and the second icon **112** can be embossed or debossed on the front layer **116**, such as through stamping, molding, etching, or bulk micromachining.

The first icon **111** and the second icon **112** can include alphanumeric text. For example, the first icon **111** can include a printed, embossed, and/or debossed "A", and the second icon **112** can include a printed, embossed, and/or debossed "B". In a similar example, the first icon **111** can include a printed, embossed, and/or debossed "1", and the second icon **112** can include a printed, embossed, and/or debossed "2". The sheet **110** can also define additional icons, such as a third icon including a printed, embossed, and/or debossed "C" or 3", a fourth icon including a printed, embossed, and/or debossed "D" or 4", etc. aligned with a third input region and/or a fourth input, etc. Alternatively, the first icon **111** and the second icon **112** can include descriptions or other symbols. For example, The sheet no can define the first icon **111** that reads "Credit," the second icon **112** that reads "Debit," a third icon that reads "Gift," and a fourth icon that reads "Driver's License." However, the sheet no can define the first icon in, the second icon **112**, etc. that are of any other form and printed or formed on the sheet no in any other suitable way.

As described above, the sheet no can includes two (or more) layers that house or "sandwich" various components of the payment card **100**. Each of the two layers can be of the same or similar material, such as polyvinyl chloride (PVC), polyethylene terephthalate (PETG), or another polymer or silicone-based elastomer. Alternatively, the layers can be of disparate materials. For example, the sheet no can include a front layer **116** of chemically-strengthened alkali-aluminosilicate glass and a back layer **117** of polyurethane. The assembly of layers (i.e., the sheet no) can also be flexible to approximate the "feel" of a standard PETG or PVC plastic bank card. The layers can be assembled with an adhesive, through hot or cold lamination, through surface activation, or by any other suitable process or technique. However, the sheet no can include any other materials, can define the first icon **111** and the second icon **112** in any other way, can be of any other form or geometry, and can feature any other mechanical property.

The transducer **150** of the payment card **100** is arranged within the sheet no and is configured to generate a voltage output in response to an impulse on a surface of the sheet **110**. Generally, the transducer **150** functions to convert a mechanical impulse (e.g., a tap) on a surface of the payment card **100** into an electrical signal of magnitude sufficient to 'wake' the processor **160** from a passive mode to an active mode. For example, the transducer **150** can be piezoelectric transducer electrically coupled to an 'wake' interrupt-enabled input pin of the processor **160**, wherein the transducer **150** outputs a voltage greater than 2.5V, which triggers the processor **160** to switch from a passive, low-current draw mode to an active, higher-current draw mode.

In the implementation in which the sheet **110** includes two layers, the transducer **150** can be arranged between the two layers, such as on the flexible circuit board **180** housed between the two layers. The transducer **150** can therefore be fabricated or installed across an inner broad face of one layer of the sheet **110**, such as across a portion of the inner broad face of the back layer **117** of the sheet **110**. The transducer **150** can also be aligned with a region of the sheet **110** that is substantially tactilely accessible to a user when the payment card **100** is held. For example, the form factor of the payment card **100** can be such that a user instinctively grasps the top and bottom long edges of the card between the thumb and the index and middle fingers of one hand and taps the card near the center of its broad face with the index finger of the other hand to wake the card from the passive setting. In this example, the transducer **150** can be arranged near the center of the broad face of the card.

Furthermore, the transducer **150** can be arranged proximal a portion of the payment card **100** likely to exhibit substantial deflection in response to a typical impulse. The transducer **150** may output a voltage potential proportional to its deflection, and the transducer **150** may therefore be arranged proximal a region of the sheet **110** that exhibits maximum deflection under impact. In one example implementation in which the payment card **100** is of a form factor similar to that of a standard plastic bank card, when a user grasps the top and bottom long edges of the card between the thumb and the index and middle fingers of one hand and taps the card near the center of its broad face with the index finger of the other hand, the sheet **110** may exhibit maximum deformation along a line substantially parallel to and equidistant from the long edges of the sheet no. In a similar example implementation, when the user grasps the left and right short edges of the card between the thumb and the index and middle fingers of one hand and taps the card near the center of its broad face with the index finger of the other hand, the sheet **110** may exhibit maximum deformation along a line substantially parallel to and equidistant from the short edges of the sheet **110**. Therefore, the transducer **150** can be substantially aligned with the center of the broad face of the sheet **110** to substantially ensure that an impact (e.g., tap) on the payment card **100** will yield a voltage spike, from the transducer **150**, of a magnitude sufficient to wake the processor **160** from the passive setting to the active setting substantially regardless of how the card is held by the user. However, the transducer **150** can be any other type of transducer arranged in any other way within the payment card **100**.

The wireless communication module **120** of the payment card **100** functions to establish a wireless connection with a mobile computing device (e.g., a smartphone, a tablet, or any other external device) to enable wireless data transfer to the payment card **100**. Generally, the wireless communication module **120** can enable communications between the payment card **100** and the mobile computing device to download payment method data (e.g., magnetic sequence commands for various payment methods) and to authenticate use of the payment card **100** to complete a transaction, as described below. The wireless communication module **120** can include both a wireless receiver and a wireless transmitter that enable two-way communication between the payment card **100** and

the mobile computing device. For example, the wireless communication module **120** includes a short-range wireless transceiver, such as a Bluetooth communication module. However, the wireless communication module **120** can implement any other suitable type of wireless communication protocol, such as Wi-Fi, cellular, or ZigBee.

The wireless communication module **120** can be fabricated or installed on the flexible circuit board **180** and can include a radio antenna **122** tailored to a particular wireless communication frequency. For example, the wireless communication module **120** can include a Bluetooth transceiver configured to exchange data wirelessly in the industrial, scientific and medical (ISM) radio bands between 2400 and 2480 MHz, and the radio antenna **122** can be sized for the frequency band between 2400 and 2480 MHz. The radio antenna **122** can be integrated into the flexible circuit board **180** as a trace and can include a linear segment. Because the payment card **100** may flex, such as under an impact to wake to processor or to mimic a standard plastic bank card as described above, the linear segment of the radio antenna **122** may deform, thereby affecting an effective length of the antenna. Therefore, the linear segment can be arranged proximal a region of the sheet **110** subject to minimal relative deflection, such as adjacent and parallel to a short edge of the sheet **110** (i.e., perpendicular to a long edge of the sheet no). The wireless communication module **120** can also include a crystal oscillator installed or fabricated on the flexible circuit board **180**. Flexure of the sheet no can induce strain across the crystal oscillator, thereby modifying a clock speed of the crystal oscillator **121**. For example, strain across the crystal oscillator **121** can reduce the clock speed of the crystal oscillator **121** from 2400 MHZ to 2390, which falls outside of the ISM range suitable for Bluetooth communication. Therefore, the crystal oscillator **121** can be arranged proximal a region of the sheet no subject to minimal relative deflection, such as adjacent (and parallel) to a short edge of the sheet no. However, the wireless communication module **120** can include any other type of antenna or oscillator arranged in any other way.

In one alternative implementation, the wireless communication module **120** can include an optical sensor, such as a photoresistor or photodiode, to enable optical transmission of data from the mobile computing device to the payment card **100**. For example, to upload a magnetic sequence command for a payment method to the payment card **100**, a user can place the payment card **100** over a screen of a smartphone with a long edge aligned with a long edge of the screen and a short edge aligned with a short edge of the screen, and a native application executing on the smartphone can switch a set of pixels adjacent the optical sensor in the payment card **100** between black (e.g., representing a '0' bit) and white (e.g., representing a '1' bit) states to transmit data to the payment card **100**. Furthermore, the wireless communication module **120** can include an optical transmitter, such as an infrared light-emitting diode (LED), to enable optical transmission of data from the payment card **100** to the mobile computing device. However, the wireless communication module **120** can receive and/or transmit data from and/or to the mobile computing device over optical communication in any other suitable way.

In one alternative implementation shown in FIG. **4** the wireless communication module **120** can include an acoustic transducer, such as a microphone, configured to receive audio signals and to convert audio signals into electrical impulses. For example, to upload a magnetic sequence command for a payment method to the payment card **100**, a user can place the payment card **100** adjacent a speaker of a smartphone, and a native application executing on the smartphone can control a speaker driver to transmit card data acoustically to the payment card **100**. The wireless communication module **120** can further include a speaker and speaker driver to enable similar acoustic communication of data from the payment card **100** to the mobile computing device. In this implementation, the processor **160** can pass digital data stored in memory through an audio CODEC where it is converted to an analog signal. The analog signal can then amplified through a speaker and transmitted wirelessly as sound waves. The analog signal can be transmitted according to frequency shift keying (FSK), on-off keying (OOK), or phase shift keying (PSK) techniques, such as with around a frequency of 20 kHz. However, the wireless communication module **120** can function in any other way and include any other suitable component to enable wireless communication of data between the payment card **100** and the mobile computing device.

The first input region **131** and the second input region **132** of the payment card **100** are arranged within the sheet **110** adjacent the first icon **111** and adjacent the second icon **112**, respectively. Generally, the first icon **111** and the second icon **112** function to capture inputs on the sheet no to enable user selection from available payment methods and to enable authentication of the payment card **100** for a payment, as described below. As described above, the payment card **100** can include additional input regions, such as a third input region aligned with a third icon and a fourth input region aligned with a fourth icon.

In one implementation, the first input region **131** includes a first touch sensor, and the second input region **132** includes a second touch sensor, and the first and second touch sensors can be discrete. Alternatively, the first and second touch sensors can be physically coextensive, wherein a single touch sensor can be arranged behind the first icon **111** and the second icon **112** to capture inputs over both the first icon **111** and the second icon **112**. The first input region **131** and/or the second input region **132** can therefore include a capacitive touch sensor, an optical touch sensor, a resistive touch sensor, or any other suitable type of touch sensor. Furthermore, as in the implementation described above in which the sheet **110** includes a front layer **116** and a back layer **117** that sandwich a flexible circuit board **180**, the first touch sensor and the second touch sensor can be installed or fabricated on the flexible circuit board **180** and configured to detect a touch on the surface of the sheet **110** through the front layer **116**. However, the first and second touch sensors can be arranged in any other way and can function in any other way to detect a touch on a surface of the sheet no.

In another implementation, the first input region **131** includes a first mechanical switch, and the second input region **132** includes a second mechanical switch. The first and second mechanical switches can each be a dome switch or any other suitable type of mechanical momentary switch. The dome switch can be installed on the flexible circuit board **180**, the flexible circuit board **180** can be installed or 'potted' over an interior broad face of a back layer **117** of the sheet no, and the front layer **116** of the sheet no can be flexible (e.g., a silicone-based elastomer) and overlaid on top of the flexible circuit board **180** and mechanical switches such that a user may depress the first icon **111**, the forward-facing layer of the sheet no may deform locally, and the first mechanical switch may close to trigger an input. In this configuration, the user may similarly depress the second icon **112**, the forward-facing layer of the sheet **110** may deform locally, and the second mechanical switch may close to trigger a second input. However, the first input region **131** and the second input region **132** can include any other type of contact or contact-

less sensor to detect an input on a surface of the sheet **110** proximal the first icon **111** and the second icon **112**.

The magnetic stripe emulator **140** of the payment card **100** functions to imitate one or more tracks of a static magnetic stripe of a standard plastic bank card. As shown in FIG. **2**A, the magnetic stripe emulator **140** can include a set of (i.e., one or more) electromagnetic coils **141** controlled by the processor **160** through a coil drive circuit **142** to output data in the form of changing magnetic field polarities. For example, as shown in FIG. **2**A, the magnetic stripe emulator **140** can include a set (i.e., one or more) coil **141** and a coil drive circuit **142** that includes a transistor **144**, a resistor **145**, and a diode **146**. A voltage on the gate of transistor can enable current to flow from a battery **170** to a coil, and the resistor can enable a drive current through the coil. The diode can be coupled in parallel with the coil to protect against voltage pulses inherent in coil inductance. The coils drive circuit can additionally or alternatively include an H-bridge to drive the coil in both positive and negative directions to reverse a magnetic field output.

Generally, the processor **160** can control the coil drive circuit according to a magnetic sequence command to switch a polarity of one or more coils in the magnetic stripe emulator **140**. For example, the coil drive circuit can pass current through a coil of the magnetic stripe emulator **140** in a first direction to represent a '0' bit, and the coil drive circuit can switch the direction of current passing through the coil to represent a '1' bit. Each magnetic stripe sequence command can include a series of bits (i.e., '0's and '1's) representing a set of bits in a static magnetic stripe in a corresponding plastic bank card, and the processor **160** can control the coil drive circuit according to the bits in the magnetic stripe sequence command to enable the magnetic stripe emulator **140** to imitate the corresponding static plastic bank card.

In one example implementation, a magnetic sequence command includes data commonly included in a Track 2 standard (i.e., a banking industry magnetic tripe standard) including: a start sentinel (e.g., ';); a primary account number (PAN) (e.g., a credit card number); a separator (e.g., '='); an expiration date (e.g., alphanumeric characters in the form of 'YYMM'); a service code (e.g., a first digit specifying interchange rules, a second digit specifying authorization processing, a the third digit specifying a range of services); discretionary data (e.g., a card verification code (CVV); an end sentinel (e.g., '?'); and/or a longitudinal redundancy check (LRC) (e.g., a validity character calculated from other data on the track). The processor **160** can control the magnetic strip emulator, through the coil drive circuit, to sequentially output bits corresponding to the any of the foregoing data. The processor **160** can also control a first coil of the magnetic stripe emulator **140** according Track 2-type data and a second coil of the magnetic stripe emulator **140** according to another data structure, such as Track 1-type or Track 3-type data.

The processor **160** and the magnetic stripe emulator **140** can also cooperate to detect a read head of a magnetic stripe reader (shown in FIG. **5**) as the payment card **100** is swept along the read head, and the processor **160** can drive the set of electromagnetic coils, via the coil drive circuit, according to the position and/or velocity (i.e., speed and direction) of the magnetic stripe emulator **140** relative to the read head as the payment card **100** is passed through the magnetic stripe reader. In one example, the magnetic stripe emulator **140** can include a first coil configured to sense a read head and a second coil to output bits according to a magnetic sequence command. In another example, the processor **160** can cooperate with a coil of the magnetic stripe emulator **140** to detect a read head, and, once a read head is detected, the processor **160** can control the coil via the coil drive circuit to output bits according to a magnetic sequence command. By detecting a read head through the magnetic stripe emulator **140**, the processor **160** can time or 'clock' sequential bits output by the magnetic stripe emulator **140** such that the payment card **100** appears to a standard magnetic stripe reader as a typical static plastic bank card and such that a standard magnetic stripe reader can detect and decipher magnetic pulses from the magnetic stripe emulator **140** (substantially) without modification. The processor **160** can thus "couple" the magnetic tripe emulator to a read head of a magnetic stripe reader as the payment card **100** is swiped through the magnetic stripe reader, as shown in FIG. **5**. However, the magnetic stripe emulator **140** can include any other number of coils configured to detect or output any other data to a magnetic read head in any other suitable way.

The magnetic stripe emulator **140** can also be arranged parallel to and offset from a long edge of the polymer layer. For example, the magnetic stripe emulator **140** can be arranged in a location similar to a standard static magnetic stripe position on a standard plastic bank card. Furthermore, the set of electromagnetic coils of the magnetic stripe emulator **140** can be of a length and width similar to that of a standard static magnetic stripe on a standard plastic bank card. For example, the coils of the magnetic stripe emulator **140** can be arranged approximately 0.223" (5.66 mm) from each short edge of the payment card **100** and can be approximately 0.375" (9.52 mm) in width. Such arrangement of the magnetic stripe emulator **140** in the payment card **100** may thus enable the payment card **100** to be read by standard magnetic stripe readers already in use to read standard (i.e., static) plastic bank cards. However, the magnetic stripe emulator **140** can be arranged in any other way, can be of any other form or geometry, and can function in any other way to imitate a static magnetic stripe of a plastic bank card.

The processor **160** of the bank card is arranged within the sheet **110** and is configured to transition from a passive setting to an active setting in response to receiving a voltage output from the transducer **150**, to receive the first magnetic sequence command associated with a first payment method and the second magnetic sequence command associated with a second payment method through the wireless communication module **120**, to assign the first payment method to the first input region **131** and the second payment method to the second input region **132**, to receive the selection for the second payment method from the second input region **132** in response to an input adjacent the second icon **112**, and to control the magnetic stripe emulator **140** according to the second magnetic sequence command in response to the selection for the second payment method. Generally, the processor **160** function to control the magnetic stripe emulator **140** according to a tap on the payment card **100**, available payment methods stored on the payment card **100**, availability of a wireless connection with a mobile computing device, inputs on the input regions, and/or selection of a payment method through the input region, etc.

As described above the processor **160** can be electrically coupled to the transducer **150** via a trace on the flexible circuit board **180**. In particular an output of the transducer **150** can be electrically coupled to an interrupt input of the processor **160** such that a voltage spike generated by the transducer **150** in response to a tap on a surface of the payment triggers the processor **160** to switch from a passive (i.e., low-power) state to an active setting in which the processor **160** monitors various inputs from the wireless communication module **120**, the input regions, the magnetic stripe emulator **140** (e.g., to detect a read head of a magnetic stripe reader), etc. and

generates various outputs to control the magnetic stripe emulator **140** and/or other components of the payment card **100**. For example, when the processor **160** receives a voltage spike from the transducer **150** and transitions from the passive setting to the active setting, the processor **160** can toggle one or more LEDs within the payment card **100** to provide visual feedback to a user that the payment card **100** is activated or 'ON.'

Alternatively, the processor **160** can be coupled to another input mechanism on the payment card, such as a mechanical switch, a strain gauge, a light or infrared detector, etc., and the processor can transition out of a passive setting in response to an input or output state change of the input mechanism. However, the processor **160** can interface or receive an output from any other suitable component within the payment card **100** to initiate an active mode or a payment mode on the payment card **100**.

Once in the active setting, the processor **160** can interface with the wireless communication module **120** to attempt wireless communication with the mobile computing device. In one implementation, the processor **160** cooperates with the wireless communication module **120** to identify and connect to a paired mobile computing device (e.g., wireless-enabled a smartphone or tablet). For example, the wireless communication module **120** can include a Bluetooth module, the processor **160** can store a unique Bluetooth serial identification number of the paired mobile computing device, and the processor **160** can cooperate with the wireless communication module **120** to identify the mobile computing device, within range of the payment card **100**, via the unique Bluetooth serial identification number. In this example, the wireless communication module **120** can assume a 'master' function to identity one or more other Bluetooth modules within range, identify a particular Bluetooth module of the paired mobile computing device based on a stored identifier of that Bluetooth module, and establish a connection with the particular Bluetooth module in a 'slave' function. Because the mobile computing device may have a more precise clock than that coupled to the wireless communication module **120**, once a connection is established between the payment card **100** and the mobile computing device, the mobile computing device can assume the master function and the payment card **100** can assume the slave function. Once a connection is established between the payment card **100** and the mobile computing device, the processor **160** can control one or more LEDs within the payment card **100** to provide visual feedback to a user that the connection was successful. For example, the processor **160** can flash a green LED three times once the connection is established. Similarly, the processor **160** can flash a red LED three times if a wireless connection with the particular mobile computing device fails. However, the processor **160** and the wireless communication module **120** can cooperate in any other way to identify, pair, and communicate with a particular mobile computing device within range.

Once the mobile computing device is identified and a wireless connection is established between the wireless communication module **120** and the mobile computing device, the processor **160** can cooperate with the wireless communication module **120** to download a magnetic sequence command associated with a particular payment method from the mobile computing device. For example, a native application executing on the mobile computing device can capture, store, and handle information for various cards. In this example, for a single bank card, the native application can store an issuing entity (e.g., a bank), an assignee (i.e., a name on the bank card), a card number, an expiration date, a verification number (e.g., a CVV number), a rewards account or username associated with the bank card, a magnetic sequence stored on a static magnetic stripe, etc. Furthermore, in this example, the processor **160** can communicate with the mobile computing device, via the wireless communication module **120**, to retrieve relevant information for a particular bank card, such as the magnetic sequence of the particular bank card in the form of a magnetic sequence command.

In one example implementation, once a wireless connection is established between the payment card **100** and the mobile computing device, the processor **160** cooperates with the wireless communication module **120** to synchronize or 'sync' with the native application executing on the mobile computing device, wherein the processor **160** downloads pertinent information (i.e., a magnetic sequence command) for each of a number of plastic bank cards corresponding to the number of input regions on the payment card **100**. In one example in which the payment card **100** includes the first input region **131** adjacent the first icon **111** and the second input region **132** adjacent the second icon **112**, the processor **160** can sync with the native application to download a first magnetic sequence command for a first payment method and a second magnetic sequence command for a second payment method. In another example in which the payment card **100** includes the first input region **131** adjacent the first icon **111**, the second input region **132** adjacent the second icon **112**, and a third input region adjacent a third icon, the processor **160** can sync with the native application to download a first magnetic sequence command for a first payment method, a second magnetic sequence command for a second payment method, and a third magnetic sequence command for a third payment method. The magnetic sequence commands downloaded to the payment card **100** from the mobile computing device can include magnetic sequence commands for a default selection of available payment methods, a ranked selection of available payment methods, a manual selection of available payment methods (e.g., a selection entered by a user through an interface within the native application), or any other suitable selection of available payment methods.

The processor **160** can automatically sync with the native application once a wireless connection is established between the wireless communication module **120** and the mobile computing device. Alternatively, the native application can push payment method information to the payment card **100** in response to a manual input entered through the native application, or the processor **160** can request a payment method update in response to a manual input on one or more input regions of the payment card **100**. For example, the processor **160** can receive sequence of inputs through the input regions (i.e., the first input region **131**, the second input region **132** and/or any additional input region), correlate the series of inputs with a request to sync with the native application, and transmit a request to the mobile computing device, via the wireless communication module **120**, to sync an updated selection of payment methods. However, the processor **160** can function in any other way to download magnetic sequence commands corresponding to one or more payment methods from the mobile computing device via the wireless communication module **120**.

In one alternative described in U.S. Provisional Application No. 61/848,581, which is incorporated in its entirety by reference, the processor **160** can also implement a "quick-sync" feature to download payment method data from the mobile computing device. For example, a user can select a specific payment method for one-time use (i.e., a single active session or one swipe) through the native application, and the wireless communication module **120** can sync with the native application (through the quick-sync feature) once a wireless

connection is established to download the specific payment method for one-time use. In this example, the quick sync feature can thus enable the user to communicate instructions to the payment card **100** to emulate a specific payment method for one-time use without changing payment method assignments for the input regions.

The processor **160** subsequently functions to assign each payment method—corresponding to a received magnetic sequence command—to one input region on the payment card **100**. In one implementation, the processor **160** receives a first magnetic sequence command corresponding to a first payment method and a second magnetic sequence command corresponding to a second payment method, and the processor **160** subsequently associates the first magnetic sequence command with the first input region **131** (and therefore the first icon **111**) and associates the second magnetic sequence command with the second input region **132** (and therefore the second icon **112**). In one example of this implementation, the processor **160** can receive an input on the first input region **131**, correlate the input with a selection for the first payment method, and thus power the magnetic stripe emulator **140** according to the first magnetic sequence command to enable payment with the first payment method, as described below. Subsequently, the processor **160** can receive an input on the second input region **132**, correlate the input with a selection for the second payment method, and thus power the magnetic stripe emulator **140** according to the second magnetic sequence command to enable payment with the second payment method.

As described above, the processor **160** can receive a ranked set of payment methods, and the processor **160** can assign the corresponding magnetic sequence commands according to their rankings. For example, the native application can rank three payment methods, including a credit card as a first payment method, a debit card as a second payment method, and a gift card as a third payment method, the processor **160** can receive the ranked set of three payment methods, and the processor **160** can assign the set of payment methods to the first input region **131**, the second input region **132**, and a third input region accordingly. As described below, the native application executing on the mobile computing device can display a virtual representation of the input regions of the payment card **100** and an overlay on top of each virtual input region indicating the particular payment method assigned to each particular input region. The mobile computing device can thus function as a remote display for the payment card **100** to provide visual information pertaining to payment methods assigned to various input regions without necessitating a refreshable display within the payment card **100**. However, the processor **160** can assign payment methods to respective input region in any other way or according to any other rank, schema, or process.

Thus, when a user taps on the payment card **100** and the processor **160** wakes from a passive setting, the processor **160** can attempt wireless communication with the mobile computing device through the wireless communication module **120** to authenticate use of the payment card **100**. Generally, the payment card **100** can be linked (i.e., paired) to the mobile computing device, and the processor **160** can require identification of and communication with the mobile computing device before enabling a payment function of the magnetic stripe emulator **140**. For example, the payment card **100** can function under the assumptions that a valid user (i.e., a valid owner) of the payment card **100** will carry both the payment card **100** and the mobile computing device on his person when attempting a transaction and that an invalid user (i.e., a thief) of the payment card **100** may only have the payment card **100** and not the mobile computing device paired with the payment card **100**. Thus, the processor **160** can implement a level of security to prevent fraudulent use of the payment card **100** by necessitating a connection between two components of the payment system (i.e., the payment card **100** and the mobile computing device) substantially likely to be carried together by a valid user but substantially unlikely to be carried together by an invalid user. Furthermore, when the payment card **100** and the paired mobile computing device establish a wireless connection, the payment card **100** can sync with the mobile computing device to download new or updated payment method information (e.g., magnetic stripe sequence commands) from the mobile computing device, such as in response to an automatic sync'ing feature or a manual sync request.

Alternatively, if the processor **160** and the wireless communication module **120** fail to establish a wireless connection with the mobile computing device, the processor **160** can suppress a payment function of the magnetic stripe emulator **140** (e.g., by suppressing power to the magnetic stripe emulator **140**) to prevent use of the payment card **100** in a transaction. However, instances may occur in which a valid user has lost or forgotten the paired mobile computing device, the mobile computing device has 'died' or run out of battery charge, or a short-range wireless communication (e.g., Bluetooth) function on the mobile computing device is turned OFF, and the processor **160** can account for these situations by authorizing use of the payment card **100** with a passcode (e.g., a personal identification number or PIN) entered directly into the payment card **100**. For example, the processor **160** can receive a series of inputs entered into the input regions, compare the series of inputs to a passcode stored on the payment card **100** (i.e., in memory), and authenticate use of the payment card **100** if the series of inputs matches the passcode. In this example, when a user first creates an account with the native application executing on the mobile computing device, the native application can display a virtual representation of the input regions on the display of the mobile computing device, prompt the user to enter a sequence of inputs on the input regions (e.g., a sequence of four inputs), store the sequence of inputs as a personal passcode for the user, and transmit the passcode to the payment card **100** upon a subsequent sync event.

Alternatively, the processor **160** can implement similar methods to interface with the transducer **150** to authenticate a series of taps on a surface of the sheet **110** as a passcode. For example, the processor **160** can authenticate a specific number, sequence, and/or interval (e.g., timing) of impulses on the sheet **110** as a passcode and thus unlock the payment card **100** for use. However, the processor can implement any other method or technique to authenticate use of the payment card **100** through an input, tap, or impulse on a surface of the sheet **110**.

Therefore, the processor **160** can lock a payment function of the magnetic stripe emulator **140** until the wireless communication module **120** establishes a connection the mobile computing device or until a user enters a valid passcode directly into the payment card **100** via the input regions. The processor **160** can thus enable security features of the payment card **100** to prevent use of the payment card **100** by an invalid or unauthorized user but also to enable access to the payment function of the card for a valid user who is either carrying the paired mobile computing device or who knows the passcode. Furthermore, once a valid passcode is received, the processor **160** can control one or more visual elements within the payment card **100** to provide visual feedback to a user that the passcode was authenticated, such as by flashing

a green LED three times. Similarly, the processor **160** can flash a red LED three times if the passcode attempt was invalid. However, the processor **160**, the input regions, and/or the wireless communicate module can cooperate in any other way to authenticate use of the payment card **100** for an upcoming payment.

Once the processor **160** authenticates use of the payment card **100** through a connection with the mobile computing device or through a valid passcode manually entered on the payment card **100**, the processor **160** can cooperate with the input regions to receive a selection for a particular payment method from a set of payment methods assigned to the input regions. In one example, the processor **160** sets a first payment method assigned to the first input region **131** as a default payment method such that, when swiped through a magnetic stripe reader, the processor **160** controls the magnetic stripe emulator **140** according to the first magnetic sequence command associated with the first payment method. However, in this example, if the user selects the second input region **132** assigned to the second payment method, the processor **160** can switch from a first payment mode corresponding to the first payment method to a second payment mode corresponding to the second payment method. Subsequently, when the payment card **100** is swiped through a magnetic stripe reader, the processor **160** can control the magnetic stripe emulator **140** according to the second magnetic sequence command to enable payment through the second payment method.

The processor **160** can correlate a single input on a single input region as a selection for a payment method assigned to the single input region, such as described above. In this implementation, the payment card **100** can store magnetic sequence commands for a number of payment methods corresponding to the number of input regions on the payment card **100**. The processor **160** can further identity substantially simultaneous inputs on two or more input regions as selection of an additional payment method. For example, the processor **160** can identify substantially simultaneous inputs on the first input region **131** and the second input region **132** as selection of a third payment method.

In another implementation, the processor **160** can respond to one or more inputs on the inputs regions by scrolling through a set of payment methods stored in memory on the payment card **100**. The processor **160** can thus access and enable more payment methods than input regions on the payment card **100**. In one example, the processor **160** defaults to a standard mode, wherein each input region is associated with a single payment method in a set of preferred, default, or most-used payment methods, but switches to a scroll mode when the user depressed two or more input regions for a threshold period of time. In the scroll mode the processor **160** can respond to an input on the first input region **132** by scrolling upward through a list of stored payment methods, the processor **160** can respond to an input on the second input region **132** by scrolling downward through the list of stored payment methods, and the processor can respond to an input on a third input region by selecting a particular payment method for subsequent emulation. Alternatively, the processor **160** can respond to a taps on the sheet **110** by scrolling through the list of stored payment methods. The processor **160** can also interface with the mobile computing device, via the wireless communication module **120** to display a currently-selected payment method and adjacent payment methods in the list of stored payment methods.

However, the processor **160** can assign payment methods to one or a combination of input regions in any other suitable way and can determine user selection of a payment method through one or more input region according to any other schema.

In applications in which the processor **160** has established a wireless connection with the mobile computing device through the wireless communication module **120**, the processor **160** can further transmit a user selection for a payment method to the mobile computing device through the wireless communication module **120**. In one implementation, the native application executing on the mobile computing device manipulates the receive payment method selection to provide visual feedback of a user's payment method section. For example, the native application can display a virtual representation of the payment card **100**, including the first icon **111** and the second icon **112**, and highlight an icon corresponding to the selected payment method, such as with a green border or bold typeface. However, the processor **160** can transmit a payment method selection to the mobile computing device in any other way, and the native application executing on the mobile computing device can provide any other suitable type of feedback to a user in any other way.

Alternatively, the native application can receive a user selection for a payment method through the mobile computing device, such as through a touchscreen displaying a list of available payment methods or a virtual representation of the payment card **100**, including virtual representations of the first and second icons assigned to a first payment method and a second payment method, respectively. The mobile computing device can then push the user payment method selection to the payment card **100**. However, the processor **160** can function in any other way to receive a user payment method selection directly through an input region or indirectly through the mobile computing device.

Once a payment method is selected manually by a user or by default, the processor **160** can control the magnetic stripe emulator **140** according to a magnetic sequence command corresponding to the selected payment method. Generally, as described above, the magnetic stripe emulator **140** can include a set of coils and a coil drive circuit, and the processor **160** can control the coil drive circuit to drive the set of coils according to a magnetic sequence command. In one implementation and as described above, the processor **160** and the magnetic stripe emulator **140** cooperate to detect a read-head of a magnetic stripe reader, and the processor **160** can couple the magnetic stripe emulator **140** to the read-head of a magnetic stripe reader by stepping through the selected magnetic sequence command according to a position and/or velocity of the payment card **100** relative to the read head.

As described above, the processor **160** can cooperate with the magnetic stripe emulator **140** to detect a local read head of a magnetic stripe reader. The processor **160** can also cooperate with the magnetic stripe emulator **140** to detect a speed or velocity of the magnetic stripe emulator **140** along the read head. In one implementation, once a local read head is detected, the processor **160** steps through bits specified in a magnetic sequence command according to a speed of the magnetic stripe emulator **140** moving along the read head. In this implementation, the processor **160** can determine a speed of the payment card **100** along the read head, calculate a magnetic stripe emulator bit rate by multiplying the speed of the card by a standard magnetic stripe bit density, and step through the magnetic sequence command (i.e., control the magnetic stripe emulator **140**) according to the magnetic stripe emulator **140** bit rate. For example, the magnetic sequence command can include Track 2-type data with a bit density of seventy-five bits per inch, the processor **160** can estimate a speed of the payment card **100** along the read head

of two inches per second, calculate a magnetic stripe emulator bit rate of 150 bits per second, and control the magnetic stripe emulator **140** to step through 150 bits per second. The processor **160** can also select a magnetic stripe emulator bit rate that is faster than a product of the estimated payment card speed and the magnetic stripe bit density to ensure the magnetic sequence is fully output before the payment card **100** exits the magnetic stripe reader. As in the foregoing example, the processor **160** can set a magnetic stripe emulator bit rate that of 165 bits per second, which is ten percent greater than the product of the estimated payment card speed and bit density.

As shown in FIG. **2**A, the payment card **100** can additionally or alternatively include one or more discrete read head sensors **148** arranged within the sheet **110** and configured to detect a read head of a magnetic stripe reader, and the processor **160** can cooperate with the one or more read head sensors **148** to couple the magnetic stripe emulator **140** to the magnetic stripe reader. The processor **160** can also interface with an accelerometer, gyroscope, Hall effect sensor, or other sensor within the payment card **100** to detect a read head and/or to determine a speed of the payment card **100** along a read head. However, the processor **160** can control the magnetic stripe emulator **140** in any other suitable way and according to any other schema.

Once payment through the payment card **100** is authenticated and/or once a user selects a payment method, the processor **160** can set a payment timer, such as a two-minute or a five-minute timer. Upon expiration of the payment timer, the processor **160** can cut power to the magnetic stripe emulator **140**, return to the passive setting, or otherwise terminate a payment function of the payment card **100**. Alternatively, once the payment card **100** is swept through a magnetic stripe reader during a transaction, the processor **160** can terminate the payment function of the payment card **100**. Similarly, once the payment card **100** is swept through a magnetic stripe reader during a transaction, the processor **160** can initiate a payment timer, such as a ten-second or one-minute timer, wherein the processor **160** withdraws the payment function of the payment card **100** and returns to the passive setting if an additional swipe is not attempted prior to expiration of the timer. However, the processor **160** can discontinue the payment function of the payment card **100** and/or return to the passive state in any other way and according to any other trigger or timer.

As shown in FIG. **2**A, one variation of the payment card **100** includes a flexible circuit board **180** board arranged within the sheet no. As described above and shown in FIG. **2**B, the flexible circuit board **180** can be sandwiched between two layers of the sheet **110** and can include traces, contacts, and/or via to communicate analog and/or digital signals between various electronic components of the payment card **100**. The flexible circuit board **180** can include a fiberglass, silicone, or polymer substrate or a substrate of any other suitable material. The flexible circuit board **180** can also be substantially thin and can include cavities or recesses to receive analog circuit components (e.g., resistors, capacitors) and/or integrated circuits (e.g., a microprocessor, a voltage regulator) such that the maximum height of the flexible circuit board **180** with components installed does not exceed a thickness of a standard plastic bank card. Furthermore, electrical components installed on the flexible circuit board **180** can exclude potting material in order to minimize component size (i.e., height). For example, the processor **160** can be a microprocessor including multiple (e.g., thousands or millions of) transistors fabricated on a silicone wafer, trimmed, shaved, and installed on the flexible circuit board **180** without encasement in a potting material. However, the flexible circuit board **180** can be of any other material, can be of any other geometry, include any other feature, and/or function in any other way to electrically couple various components of the payment card **100**.

As shown in FIG. **2**A, one variation of the payment card **100** further includes a battery **170** arranged within the sheet **110** and electrically coupled to the processor **160** via the flexible circuit board **180** board. Generally, the battery **170** functions to power the processor **160**, the wireless communication module **120**, the magnetic stripe emulator **140**, and other components of the payment card **100**. The battery **170** can be substantially thin. The battery **170** can include multiple cells that are flexible by nature of their thin cross-sections, or the battery **170** can include multiple cells with gaps therebetween such that the battery **170** can flex across the gaps. The battery **170** can be sandwiched between two layers of the sheet **110** adjacent the flexible circuit board **180**, mounted on the flexible circuit board **180**, or arranged in any other way within the payment card **100**. The battery **170** can be a lithium-ion, lithium-polymer, NiCd, or any other suitable type of battery and can be rechargeable or non-rechargeable. The processor **160** can also sense a remaining charge on the battery **170** and output battery level feedback to a user, such as by flashing an LED within the sheet no accordingly to current battery level. Alternatively, the wireless communication module **120** can transmit battery status to the native application executing on the mobile computing device to display battery information for the user.

As shown in FIGS. **3** and **4**, one variation of the payment card **100** further includes a display **190** visible through a layer of the sheet **110**. For example, the display can include an e-paper or e-ink display. The display can output alphanumeric characters corresponding to a card number of a selected payment method, a CCV of a selected payment method, a cardholder's (i.e., the user's) name, payment method assignments to input regions, or any other relevant data pertaining to a user, a payment method, or a function of the payment card **100**.

However, the payment card **100** can also include any other component and can function in any other way to consolidate multiple payment sources into one payment card with a magnetic stripe emulator configured to output a magnet form of bits to mimic static magnetic stripes of various standard plastic bank cards.

In addition or as an alternative to the magnetic stripe emulator **140**, the payment card **100** can include a near-field communication (NFC) tag emulator, a radio-frequency identification (RFID) tag emulator, and/or any other payment authorization protocol emulator. For example, the payment card **100** can include rewriteable NFC tag, the processor **160** can store NFC commerce transaction identifiers for a set of NFC-based payment methods, and the processor **160** can rewrite the NFC tag with a NFC commerce transaction identifier for a selected payment method. In another example, the payment card **100** can include an RFID reader detector and an RFID tag emulator, the processor **160** can store RFID commerce transaction identifiers for a set of RFID-based payment methods, the processor **160** can cooperate with the RFID reader detector to detect a local RFID reader, and the RFID tag emulator can output a RFID commerce transaction identifier for a selected RFID payment method. However, the payment card **100** can include and implement any other payment authorization protocol emulator, and any of the foregoing and subsequent methods can be implemented to enable consolidation of one or more plastic bank card, NFC, RFID, and/or gift card payment methods on a single payment card.

2. First Method

As shown in FIGS. **6** and **8**, first method S**100** for controlling a payment card including a magnetic stripe emulator, a first input region, and a second input region, includes: establishing a wireless connection with the payment card **100** in Block S**110**; transmitting a first magnetic sequence command to the payment card **100** over the wireless connection in Block S**120**, the first magnetic sequence command associated with a first payment method assigned to the first input region **131**; transmitting a second magnetic sequence command to the payment card **100** over the wireless connection in Block S**130**, the second magnetic sequence command associated with a second payment method assigned to the second input region **132**; and on a digital display, displaying virtual representations of the first input region **131** and the second input region **132** on the payment card **100** in Block S**140**, a visual identifier of the first payment method displayed proximal the virtual representation of the first input region **131**, and a visual identifier of the second payment method displayed proximal the virtual representation of the second input region **132**.

Generally, first method S**100** functions to enable a remote visual interface for the payment card **100** described above. In one implementation, first method S**100** can be implemented through a native application executing on a mobile computing device (e.g., a smartphone, a tablet), as described above. The payment card **100** described above can store a set of payment methods and enable payment with a payment method selected from the set of payment methods through a magnetic stripe emulator, and the payment card **100** can download different sets of payment methods over time and assign various payment methods to each input region over time. However, because the payment card **100** may omit a refreshable display, a mobile computing device paired with the payment card **100** can implement first method S**100** to provide visual feedback of payment methods assigned to each input region (or combination of input regions) on the payment card **100**.

In one example, a user attempting to make a payment with a payment method stored on the payment card **100** can wake the payment card **100** by tapping the payment card **100** as described above, the payment card **100** and the mobile computing device paired with the payment card **100** can establish a wireless connection, the mobile computing device can transmit a first payment method and a second payment to the payment card **100**, and the mobile computing device can display a virtual representation of the payment card **100** including the first input region **131** and the second input region **132** (and/or the first icon **111** and the second icon **112**) with a visual representation of the first payment method overlaid over the first icon **111** and a visual representation of the second payment method overlaid over the second icon **112** according to payment methods assigned to each input region of the payment card **100**. In this example, the user can thus reference the virtual representation of the payment card **100** displayed on the mobile computing device to identify what payment methods are available in the payment card **100** and which payment method is assigned to each input region on the payment card **100**.

Block S**110** of first method S**100** recites establishing a wireless connection with the payment card **100**. As described above, once the processor **160** in the payment card **100** wakes from a passive setting to an active setting, the processor **160** can control the wireless communication module **120** to search for, identify, and connect with a paired mobile computing device. In Block S**110**, a wireless module within the mobile computing device can cooperate with the wireless communication module **120** within the payment card **100** to establish the wireless connection. For example, the payment card **100** and the mobile computing device can communicate over Bluetooth communication protocol or any other radio-frequency-type wireless communication protocol. Alternatively, as described above, the mobile computing device can implement Block S**110** by communicating with the payment card **100** over an optical- or sound-based communication channel. As described above, Block S**110** can toggle a set of pixels on a display of the mobile computing device between black and white settings to optically transmit bits (i.e., data) to the payment card **100**. Alternatively, as described above, Block S**110** can control an audio driver (e.g., a speaker) to transmit audio signals including payment method data. However, Block S**110** can establish communication with the payment card **100** through any other suitable communication protocol over any other communication channel or pathway.

Block S**120** of first method S**100** recites transmitting a first magnetic sequence command to the payment card **100** over the wireless connection, the first magnetic sequence command associated with a first payment method assigned to the first input region **131**. Similarly, Block S**130** of first method S**100** recites transmitting a second magnetic sequence command to the payment card **100** over the wireless connection, the second magnetic sequence command associated with a second payment method assigned to the second input region **132**. As described above, the mobile computing device can implement Block S**120** by transmitting a set of payment methods to the payment card **100** over Bluetooth, over another radio-frequency-type communication protocol, through an optical connection, through an audio-based connection, or over any other suitable wireless communication protocol or communication channel.

As described, Blocks S**120** and S**130** can transmit requisite payment information for each payment method, such as a magnetic sequence command specifying a series of bits implementable magnetically through the magnetic stripe emulator **140** of the payment card **100** to imitate a static magnetic stripe of a corresponding plastic bank card.

Blocks S**120** and S**130** can also transmit a payment method rank to the payment card **100**, wherein the payment rank defines a particular payment method as a default payment method. For example, Blocks S**120** and S**130** can specify the first payment method as the default payment method such that if a user does not select an alternative payment method through one or more input regions on the payment card **100**, the payment card **100** will default to payment with the default (i.e., first) payment method.

Blocks S**120** and S**130** can additionally or alternatively transmit payment method assignments for each input region to the payment card **100**. For example, Blocks S**120** and S**130** can receive a manual selection of payment methods from a user or automatically select a set of payment methods stored in the native application executing on the mobile computing device, assign one payment method in the set of payment methods to each input region on the payment card **100**, and transmit the assignments to the card in conjunction with the magnetic sequence commands for each payment method in the set of payment methods. Thus, Blocks S**120** and S**130** can maintain a current list of payment method assignments for each input region on the card, and Block S**130** can implement the list of payment method assignments to update the virtual representation of the payment card **100** including visual identifiers of the assigned payment methods. However, Blocks S**120** and S**130** can transmit any other suitable command, data, or specification to the payment card **100** in addition to a magnetic stripe sequence of one or more selected payment methods.

Block S**120** and Block S**130** can further encrypt and/or decrypt communications with the payment card **100**, such as by implementing one or more authentication and/or encryption schema. For example, Blocks S**120** and S**130** can implement cryptographic protocols such as Diffie-Hellman key exchange or Wireless Transport Layer Security (WTLS). Blocks S**120** and S**130** can additionally or alternatively encrypt data according to an encryption standard such as Data Encryption Standard (DES), Triple Data Encryption Standard (3-DES), or Advanced Encryption Standard (AES). The payment card **100** can similarly encrypt and/or decrypt communications with the mobile computing device. However, Blocks S**120** and S**130** (and the payment card **100**) can implement any other security or encryption methods to protect private or sensitive user or banking information.

Block S**140** of first method S**100** recites, on a digital display, displaying a virtual representation of the first input region **131** and the second input region **132** on the payment card **100**, a visual identifier of the first payment method proximal the virtual representation of the first input region **131**, and a visual identifier of the second payment method proximal the virtual representation of the second input region **132**. Generally, Block S**140** functions to provide visual feedback of payment method assignments for the input regions on the payment card **100** through a refreshable display incorporated into the mobile computing device.

As shown in FIG. **8**, in one implementation, Block S**140** displays a virtual image of the payment card **100** with both a descriptor of the first payment method arranged over a portion of the virtual image corresponding to the first input region **131** and a descriptor of the second payment method arranged over a portion of the virtual image corresponding to the second input region **132**. The descriptor for each payment method can include a stock image, such as a brand image of a credit card issuer, a banking institution, or a credit card rewards program. For example, when a user uploads a plastic bank card into the native application executing on the mobile computing device, the native application can identify a rewards program associated with the plastic bank card, and Block S**140** can automatically download a corresponding stock image for the rewards program from a remote server (i.e., over the Internet) and display the stock image over a virtual representation of corresponding input region of the payment card **100**. Alternatively, when a user uploads a plastic bank card into the native application executing on the mobile computing device, the native application can prompt the user to supply a description of the plastic bank card (e.g., through a virtual keyboard displayed on a touch display of the mobile computing device), and Block S**140** can display the description proximal a virtual representation of corresponding input region of the payment card **100**. Similarly, when a user uploads a plastic bank card into the native application executing on the mobile computing device, the native application can prompt the user to select a stock textual or visual identifier of the plastic bank card, and Block S**140** can display the identifier adjacent a virtual representation of corresponding input region of the payment card **100**. However, Block S**140** can function in any other way to display a virtual representation of the payment card **100** and identifiers of payment methods assigned to each input region of the payment card **100**.

As shown in FIG. **7**, one variation of first method S**100** includes Block S**150**, which recites receiving a selection on the first input region **131** of the payment card **100** over the wireless connection and highlighting the visual identifier of the first payment method within the virtual representation of the payment card **100**. Generally, Block S**150** functions to update the virtual representation of the input regions and corresponding payment methods to indicate which payment method is currently enabled on the payment card **100**. For example, Block S**150** can highlight, expand, embolden, alter a color or, or other visually modify the identifier displayed proximal a virtual representation of an input region corresponding to the payment method currently selected for an upcoming transaction.

In one implementation, once a transaction with the payment card **100** is authenticated, such as described above, the mobile computing device implements Block S**150** by displaying a first colored (e.g., green) border around a virtual representation of an input region corresponding to a default payment method. If and when a user selects an alternative payment method by touching an input region corresponding to an other payment method, the payment card **100** can transmit the selection for the other payment method to the mobile computing device, and the mobile computing device can remove the first colored border and instead display a second colored (e.g., green) border around a virtual representation of an input region corresponding to the other payment method. However, Block S**150** can function in any other way to provide visual feedback for a selection of a payment method through the payment card **100**.

3. Second Method

As shown in FIGS. **9** and **11**, second method S**200** for controlling a payment card including a magnetic stripe emulator and a set of input regions includes: receiving a tap input on a surface of the payment card **100** in Block S**210**; in response to receiving the tap input, attempting wireless communication with a mobile computing device in Block S**220**; suppressing a payment function of the magnetic stripe emulator **140** in response to failed wireless communication with the mobile computing device in Block S**230**; receiving a series of inputs through the set of input regions in Block S**240**; authenticating the series of inputs as a passcode in Block S**250**; and in response to authenticating the series of inputs as the passcode, enabling the payment function of the magnetic stripe emulator **140** in Block S**260**.

Generally, second method S**200** can be implemented through the payment card **100** described above as a security measure to prevent fraudulent use of the payment card **100**. As described above, the payment card **100** can be paired with a mobile computing device, and because a verified user may carry both the payment card **100** and the mobile computing device but a fraudulent user may only have access to the payment card **100**, once activated, the payment can attempt to communicate with the paired mobile computing device to authenticate use of the payment card **100**. However, if the payment card **100** fails to establish a connection with the mobile computing device, the payment card **100** can implement second method S**200** to receive a passcode and authenticate use of the payment card **100**.

Block S**210** of second method S**200** recites receiving a tap input on a surface of the payment card **100**. As described above, the processor **160** of the payment card **100** can implement Block S**210** by receiving a voltage spike from a transducer (e.g., a piezoelectric transducer) in response to an impulse on the payment card **100** that deforms the sheet **110** of the payment card **100** and thus the transducer **150**. The 'tap' or impulse can thus transition the payment card **100** to an active setting. However, Block S**210** can handle a tap or impulse on the payment card **100** in any other suitable way.

Block S**220** of second method S**200** recites, in response to receiving the tap input, attempting wireless communication with a mobile computing device. As described above, the processor **160** and the wireless communication module **120**

of the payment card **100** can cooperate to detect a paired mobile computing device. Once the mobile computing device is detected, the processor **160** can attempt to establish a wireless connection with the mobile computing device by transmitting an inquiry for the mobile computing device paired through the wireless communication module **120**. Block S**220** can make a predefined number of attempts to connect to the mobile computing device, such as two or five attempts, prior to switching to an idle setting and transitioning to Block S**230**. However, Block S**220** can attempt communication with the paired mobile computing device in any other suitable way.

Block S**230** of second method S**200** recites suppressing a payment function of the magnetic stripe emulator **140** in response to failed wireless communication with the mobile computing device. Generally, Block S**230** functions to block the magnetic stripe emulator **140** of the payment card **100** from implementing a magnetic stripe sequence of a payment method, as described above. For example, Block S**230** can maintain a coil of the magnetic stripe emulator **140** in an unpowered setting. In one implementation, Block S**230** suppresses the payment function of the magnetic stripe emulator **140** in response to a predefined number of failed attempts to pair with the mobile computing device that includes a unique wireless communication address, as described above.

Alternatively, Block S**230** can suppress the payment function of the magnetic stripe emulator by communicating a 'void payment' command to a payment processing company that handles payment transactions through plastic banking cards. For example, Block S**230** can establish a wireless Internet connection (e.g., via a Bluetooth connection with an external Internet-enabled electronic device) and transmit the 'void payment' command to a server hosted by the payment processing company such that the payment processing company can void a transaction attempted with the banking card **100**. However, Block S**230** can function in any other way to withdraw or suppress a payment function of the payment card **100**.

Block S**240** of second method S**200** recites receiving a series of inputs through the set of input regions, and Block S**250** of second method S**200** recites authenticating the series of inputs as a passcode. Generally, Block S**240** captures a set of inputs, such as four discrete inputs, across the input regions of the payment card **100**, and Block S**250** compares the set of inputs to a stored passcode to authenticate use of the payment card **100** if authentication through a connection with the paired mobile computing device fails. As described above, a user can set a passcode to unlock the payment card **100** into an interface with the native application executing on the mobile computing device, the mobile computing device can transmit the passcode to the payment card **100**, and the payment card **100** can store the passcode in memory. Once Block S**240** captures the set of inputs entered by the user, Block S**250** can match a sequence of the set of inputs with a stored sequence of inputs defining the passcode to authenticate use of the payment card **100**. However, Block S**240** and Block S**250** can function in any other way to capture and authenticate a series of inputs as a valid passcode.

Block S**260** of second method S**200** recites, in response to authenticating the series of inputs as the passcode, enabling the payment function of the magnetic stripe emulator **140**. In one implementation, the processor **160** implements Block S**250** to verify a passcode entered by a user, and the processor **160** subsequently implements Block S**260** to power the magnetic stripe emulator **140** according to a default or selected payment method when the payment card **100** is passed through a magnetic stripe reader (shown in FIG. **5**).

As shown in FIG. **10**, one variation of second method S**200** includes Block S**270**, which recites receiving a selection of a particular input region, in the set of input regions, assigned to a particular payment method. Generally, Block S**270** functions to capture user selection of a particular payment method, from a set of payment methods stored on the payment card **100**, through one or more input regions on the payment card **100**. However, Block S**270** can function in any other way to receive a payment method selection from a user.

In response to receiving a payment method selection from a user, Block S**260** can enable the payment function of the magnetic stripe emulator **140** by powering a coil of the magnetic stripe emulator **140** according to a magnetic sequence command associated with the particular payment method, as described above. For example, the processor **160** can implement Block S**260** by outputting a control signal to the coil driver circuit **142**, which can generate magnetic polarity changes corresponding to the magnetic stripe sequence of the selected payment method, as shown in FIG. **11**. However, Block S**260** and Block S**270** can function in any other way to receive and to implement a payment method selection entered by a user.

As shown in FIG. **10**, one variation of second method S**200** further includes Block S**280**, which recites transitioning the coil of the magnetic stripe emulator **140** to an unpowered setting after a threshold period of time. Generally, Block S**280** functions to transition the payment card **100** to an inactive state in which the payment card **100** can not be used to provide payment information. In one implementation and as described above, the processor **160** can set a payment timer once payment through the payment card **100** is authenticated, once a payment method is selected by a user, or once the payment card **100** is swept through a magnetic stripe reader during a transaction, etc. In this variation, the processor **160** can maintain payment functionality of the payment card **100** until expiration of the timer, at which point the processor **160** implements Block S**280** to withdraw the payment function of the payment card **100** and transition the payment card **100** to the passive setting. However, Block S**280** can function in any other way to shutdown the payment card **100** after a threshold period of time or in response to any other time, timer, or trigger.

4. Third Method

As shown in FIGS. **12** and **13**, third method S**300** for controlling a payment card including a magnetic stripe emulator, a first input region, and a second input region includes: receiving a tap input on a surface of the payment card **100** in Block S**310**; in response to receiving the tap input, establishing a wireless connection with a mobile computing device in Block S**320**; receiving a first magnetic sequence command and a second magnetic sequence command from the mobile computing device in Block S**330**, the first magnetic sequence command associated with a first payment method, the second magnetic sequence command associated with a second payment method; assigning the first payment method to the first input region **131** in Block S**340**; assigning the second payment method to the second input region **132** in Block S**350**; receiving a selection for the second payment method through the second input region **132** in Block S**360**; and, in response to receiving the selection for the second payment method, driving the magnetic stripe emulator **140** according to the second magnetic sequence command in Block S**370**.

Generally, third method S**300** can be implemented through the payment card **100** described above as a security measure to prevent fraudulent use of the payment card **100**. As described above, the payment card **100** can be paired with a mobile computing device, and because a verified user may

carry both the payment card **100** and the mobile computing device but a fraudulent user may only have access to the payment card **100**, once activated, the payment can implement third method S**300** to establish a wireless connection with the paired mobile computing device, thereby authorizing use of the payment card **100** for a subsequent payment.

Block S**310** of third method S**300** recites receiving a tap input on a surface of the payment card **100**. Generally, Block S**310** can function as Block S**210** described above to transition from an inactive (i.e., passive) setting to an active setting in which the magnetic stripe emulator **140** of the payment card **100** outputs a series of bits magnetically to mimic a static magnetic stripe of a plastic bank card. For example, the processor **160** can implement Block S**310** to transition from a passive mode to an active mode in response to a voltage output from the transducer **150** arranged within the payment card **100**.

Block S**320** of third method S**300** recites, in response to receiving the tap input, establishing a wireless connection with a mobile computing device. Generally, Block S**320** functions similar to Block S**220** described above to detect and identify a paired mobile computing device. However, if Block S**320** detects the paired mobile computing device, Block S**320** can further establish the wireless connection with the mobile computing device. For example, Block S**320** can transmit an inquiry for the mobile computing device and can pair the payment card **100** to the mobile computing device over the wireless connection, as shown in FIG. **13**. However, Block S**320** can function in any other way to communicate wirelessly with the paired mobile computing device.

Block S**330** of third method S**300** recites receiving a first magnetic sequence command and a second magnetic sequence command from the mobile computing device, the first magnetic sequence command associated with a first payment method, the second magnetic sequence command associated with a second payment method. In one implementation described above in which the payment card **100** and the mobile computing device establish a radio-frequency-based wireless connection, Block S**330** can receive magnetic sequence commands for the set of payment methods though radio communications. In another implementation described above, the mobile computing device can output a series of optical signals (e.g., black and white or high and low light pulses) in the direction of the payment card **100**, and the payment card **100** can implement Block S**330** to receive and decode the optical signals into magnetic sequence commands for the set of payment methods. For example, Block S**330** can receive the optical signals through a photodiode or through a photoresistor. Similarly, in the implementation described above in which the mobile computing device outputs a series of audio signals (e.g., from a speaker or audio driver), the payment card **100** can impellent Block S**330** to receive and decode the audio signals into magnetic sequence commands for the set of payment methods. For example, Block S**330** can record a series of audio pulses through a transducer arranged within the payment card **100** and can correlate the first magnetic sequence command from the series of audio pulses.

As described above, Block S**330** can also receive a ranking for the payment methods, payment method assignments for the input regions, or any other suitable or relevant information pertaining to the payment methods. Block S**330** can also receive encrypted payment method data, and Block S**330** can further function to decrypt the received data. However, Block S**330** can function in any other way to receive and/or process information for one or more payment methods.

Block S**340** of third method S**300** recites assigning the first payment method to a first input region in the set of input regions. Similarly, Block S**350** of third method S**300** recites assigning the second payment method to a second input region in the set of input regions. Generally, Block S**340** and Block S**350** function to assign one input region to one payment method such that selection of a particular input region triggers the payment card **100** to emulate the corresponding payment method (i.e., a magnetic stripe of a corresponding plastic bank card). Block S**340** and Block S**350** can also assign a set of input regions to one payment method to enable selection of more payment methods than number of input regions on the card.

In one implementation, Block S**340** stores the first magnetic sequence command of the first payment method in a stack in computer memory and assigns an address of the first magnetic sequence command to the first input region **131**. Similarly in this implementation, Block S**350** stores the second magnetic sequence command of the second payment method in a stack in computer memory and assigns an address of the second magnetic sequence command to the second input region **132**. However, Block S**340** and Block S**350** can store and assign magnetic sequence commands for various payment methods in any other suitable way.

Block S**340** and Block S**350** can assigned each magnetic sequence command to an input region in order that each is received. Alternatively, Block S**340** and Block S**350** can assign the payment methods according to a payment method rank received from the mobile computing device, as described above. Furthermore, Block S**340** can set the first payment method as a default payment method, as described above, such that the payment card **100** defaults to emulating the first payment method when a payment is attempted through the card if a user fails to select an input region corresponding to another payment method. However, Block S**340** and Block S**350** can selectively assign each payment method to one or more input regions in any other way or according to any other schema.

Block S**360** of third method S**300** recites receiving a selection for the second payment method through the second input region **132**. Generally, Block S**360** functions to receive an input through a particular input region on the payment card **100** and to 'arm' the payment card **100** to implement the magnetic sequence command of the particular payment method. In one example, Block S**360** receives an input on the surface of the payment card **100** proximal the second input region **132** that includes a capacitive touch sensor and switches from a default payment mode specifying the first payment method to a manual payment selection mode that specifies the second payment method.

In one implementation in which Block S**240** and Block S**250** store the first and second magnetic sequence commands in a stack in computer memory and assign addresses of the magnetic sequence command to respective input regions, Block S**360** can set a pointer within the stack to a particular address in response to a selection on a corresponding input region. However, Block S**360** can function in any other way to receive and implement selection of a payment method through a corresponding input region on the payment card **100**.

Block S**370** of third method S**300** recites, in response to receiving the selection for the second payment method, driving the magnetic stripe emulator **140** according to the second magnetic sequence command. Generally, Block S**370** functions to implement a magnetic sequence command of a selected or default payment method through the magnetic stripe emulator **140** of the payment card **100** to mimic a plastic bank card when use of the payment card **100** is attempted.

As described above, Block S**370** can detect a magnetic stripe reader and power one or more coils of the magnetic stripe emulator **140** according to the default or selected magnetic sequence command according to a speed and/or position of the magnetic stripe emulator **140** relative to a read head of the magnetic stripe reader. Block S**370** can therefore function to magnetically couple the magnetic stripe emulator **140** to the magnetic stripe reader and control a magnetic polarity of the magnetic stripe emulator **140** accordingly. However, Block S**370** can function in any other way to control the magnetic stripe emulator **140** of the payment card **100**, thereby enabling payment with a selected payment method through the payment card **100**.

5. Fourth Method

As shown in FIGS. **14** and **15**, fourth method S**400** for controlling a payment card including a magnetic stripe emulator, a first input region assigned a first payment method, and a second input region assigned a second payment method includes: authorizing use of the payment card **100** in Block S**410**; initiating a timed payment mode comprising a payment timer in Block S**420**; receiving a selection for the first payment method through the first input region **131** in Block S**430**, the first payment method associated with a first magnetic sequence command stored in memory; in response to receiving the selection for the first payment method, enabling a payment function of the magnetic stripe emulator **140** with the first magnetic stripe command in Block S**440**; locking the payment function of the magnetic stripe emulator **140** against an input on the second input region **132** to select the second payment method in Block S**450**; and disabling a payment function the magnetic stripe emulator **140** in response to expiration of the payment timer in Block S**460**.

Generally, fourth method S**400** can be implemented through the payment card **100** described above to "lock" a selected payment method to the card for a specified period of time. Fourth method S**400** can therefore be useful during periods in which an owner of the payment card **100** 'hands off' the payment card **100** to another individual to make a payment. For example, fourth method S**400** can be implemented through the payment card **100** when a user (i.e., the owner of the payment card **100**) hands the payment card **100** to a waiter following a meal at a restaurant. In this example, fourth method S**400** can lock a particular payment method selected by the user to avoid incidental selection of an alternative payment method when the waiter handles the payment card **100**.

Block S**410** of fourth method S**400** recites authorizing use of the payment card **100**. In one implementation, Block S**410** can implement Blocks of second method S**200** described above by establishing a wireless connection with a paired mobile computing device and authorizing use of the payment card **100** based on the wireless connection. For example, Block S**410** can receive a tap input on a surface of the payment card **100**, transmit an inquiry for a mobile computing device paired to the payment card **100**, and establish a wireless connection with a mobile computing device to authenticate use of the payment card **100**. Additionally or alternatively, Block S**410** can implement Blocks of third method S**300** described above by receiving a series of inputs on the input regions of the card and matching the series of inputs to a passcode to authenticate use of the payment card **100**. For example, Block S**410** can receive a tap input on a surface of the payment card **100**, receive a series of inputs through the first input region **131** and the second input region **132**, and authenticate the series of inputs as a valid passcode to enable use of the payment card **100**. As described above, Block S**410** can control a visual indicator within the payment card **100** (e.g., an LED) or displayed on the mobile computing device through the native application to indicate to a user than that payment card has been authenticated. However, Block S**410** can function in any other way to authenticate use of the payment card **100** in a subsequent transaction.

Block S**420** of fourth method S**400** recites initiating a timed payment mode, as shown in FIG. **15**. Generally, Block S**420** functions to transition the payment card **100** into the timed payment mode in which a selected payment method is "locked in" (i.e., cannot be changed) for a period of time. In one implementation, the native application executing on the mobile computing device receives an input from a user specifying the timed payment mode, and Block S**420** receives a corresponding timed payment mode request from the mobile computing device. Thus, in this implementation, the mobile computing device and/or the native application can function as an external control unit for the payment card **100**.

In another implementation, Block S**420** receives a series of inputs through the first input region **131** and the second input region **132** and identifies the series of inputs as a timed payment mode request. In this implementation, Block S**410** can first receive passcode enter by a user through the input regions to authenticate use of the payment card **100** or authenticate use of the payment card **100** by establishing a wireless connection with the mobile computing device, and Block S**420** can subsequently receive a second series of inputs corresponding to a timed payment request. Alternatively, Block S**410** and Block S**420** can cooperate to receive a single passcode that both authenticates use of the payment card **100** and selects the timed payment mode as a current operating mode of the payment card **100**. For example, the payment card **100** can be configured to receive a first passcode (e.g., **1212**) to authenticate use of the payment card **100** through a standard operating mode in which payment methods can be selected at whim and the payment card **100** becomes inactive after a period of inactivity (e.g., one minute without a swipe through a magnetic stripe reader), and the payment card **100** can also be configured to receive a second passcode (e.g., **1122**) to authenticate use of the payment card **100** through the timed payment mode in which a selected payment method is locked to the card and the payment card **100** becomes inactive after a predetermined period of time.

Block S**420** can initiate the timed payment mode once a request to enter the timed payment mode is entered by a user by triggering a payment timer of a set period of time. In this implementation, Block S**430** can subsequently receive a selection for a payment method, Block S**440** can enable a payment function of the payment card **100** with the selected payment method, and Block S**460** can withdraw the payment function of the payment card **100** once the payment timer expires (i.e., after the set period of time transpires).

Alternatively, Block S**420** can initiate the timed payment mode once Block S**430** receives a selection of a payment more from a user. In this implementation, Block S**430** can receive a payment method selection, Block S**420** can initiate the payment timer, Block S**440** can enable the payment function of the payment card **100** with the selected payment method, and Block S**460** can subsequently withdraw the payment function of the payment card **100** once the payment timer expires. In this implementation, Block S**420** can initiate the timed payment mode by setting the payment timer, and Block S**430** can trigger the payment timer once a selection for a payment method is entered.

Block S**420** can specify a default timer length for the payment timer, such as five minutes. Block S**420** can also sync with the mobile computing device and retrieve a suggested timer length from the mobile computing device. For example,

the mobile computing device can estimate an optimum timer length based on a time of day, a location of the user (e.g., determined by a global positioning system sensor in the mobile computing device), a preference of the user, etc., and Block S**420** can retrieve the estimated optimum timer length from the mobile computing device. Alternatively, Block S**420** can receive a user input to control the length of the payment timer. For example, Block S**420** can receive a user input requesting the timed payment mode, control a visual indicator within the payment card **100** (e.g., an LED) or displayed on the mobile computing device through the native application to provide visual feedback that the payment card **100** is in the timed payment mode, receive a subsequent input through the payment card **100** or through the mobile computing device specifying a length of the time, and then set the length of the timer according to the user input. However, Block S**420** can function in any other way to initiate the timed payment mode.

Block S**430** of fourth method S**400** recites receiving a selection for the first payment method through the first input region **131**, the first payment method associated with a first magnetic sequence command stored in memory. Generally, Block S**430** functions like Block S**360** described above to receive an input on an input region and to correlate the input with a selection for a payment method assigned to the input region. As described above, Block S**430** can receive a selection for a particular payment method through a physical input region arranged on the payment card **100** and/or through a virtual input region displayed on a touchscreen or other display of a paired mobile computing device. However, Block S**430** can function in any other way to capture a user selection for a payment method. As described above, Block S**430** can also function to trigger the payment timer once a user selection for a payment method is captured. Block S**430** can also provide visual feedback of the payment selection through the payment card **100** (e.g., by controlling an LED within the payment card **100**) or through the native interface executing on the mobile computing device.

Block S**440** of fourth method S**400** recites, in response to the selection for the first payment method, enabling a payment function of the magnetic stripe emulator **140** through implementation of the first magnetic stripe command. Generally, Block S**440** functions like Block S**260** and Block S**370** to drive the magnetic stripe emulator **140** according to a magnetic sequence command corresponding to the selected and "locked" payment method. For example and as described above, Block S**440** can detect a magnetic stripe reader and power the magnetic stripe emulator **140** according to the first magnetic sequence command and a position and/or speed of the magnetic stripe emulator **140** relative to a read head of a magnetic stripe reader. Block S**440** can also provide visual feedback through the payment card **100** or through the mobile computing device that the payment function of the payment card **100** is active. However, Block S**440** can function in any other way to enable a payment function of the payment card **100** through a magnetic sequence command corresponding to a selected payment method.

Block S**450** of fourth method S**400** recites disregarding an input on the second input region **132** as a selection for the second payment method. Generally, Block S**450** functions to implement a "lock" feature of fourth method S**400** by ignoring additional inputs on the physical input regions of the payment card **100** or the virtual input regions displayed on a display of a mobile computing device to select (purposefully or accidentally) an alternative payment method. For example, Block S**450** can lock the magnetic stripe emulator **140** in a first payment method payment mode in response to the selection of the first payment method and prior to expiration of the payment timer such that the magnetic stripe emulator **140** cannot be switched from the first payment method payment mode to another payment method payment mode until the payment timer expires.

In one implementation, the processor **160** of the payment card **100** can implement Block S**450** by cutting power to a touch sensor, mechanical switch, or other sensor adjacent the set of input regions to withdraw input sensing capabilities of the payment card **100** once Block S**430** receives a selection for payment method. In another implementation, the processor **160** can implement Block S**450** by actively ignoring (i.e., not responding) to input signals received from the set of input regions once Block S**430** receives a selection for payment method. However, Block S**450** can be implemented in any other way to actively or passively disregard an input on an input region of the payment card **100** once a payment method is selected in Block S**430**.

Block S**460** of fourth method S**400** recites disabling a payment function of the magnetic stripe emulator **140** after a specified period of time. Generally, Block S**460** disables the payment function of the payment card **100** once the payment timer expires and/or once the payment card **100** has implemented the selected payment method in a transaction. For example, Block S**420** can set the payment timer at five minutes from selection of a payment method, Block S**430** can initiate the timer when the user selects a payment method, and Block S**460** can cancel or stop the payment function of the payment card **100** when the timer expires.

Block S**460** can also provide visual feedback that the timer is approaching expiration. For example, Block S**460** can blink an LED within the payment card **100** during the last thirty seconds on the payment timer. Block S**460** can similarly blink the LED at a rate proportional to the amount of time left on the payment timer such that the LED blinks faster as the payment timer approaches expiration.

Once the timer expires, Block S**460** can transition the magnetic stripe emulator **140** to a standby or default setting in which the magnetic stripe emulator **140** is unpowered in the default setting, as shown in FIG. **15**. Alternatively, Block S**460** can transition the payment card **100** to a passive, inactive, 'sleep,' or OFF setting. In this alternative, the payment card **100** can subsequently repeat Block S**410** to enable a subsequent payment. However, Block S**460** can function in any other way to disable the payment function of the payment card **100**.

As described above, the foregoing methods can be implemented in cooperation with or through a payment card including a NFC tag emulator, a RFID tag emulator, and/or any other payment authorization protocol emulator in addition or as an alternative to a magnetic stripe emulator. The foregoing methods can therefore enable substantially secure consolidation of one or more plastic bank card, NFC, RFID, gift card, and/or other payment method on a single payment card.

The systems and methods of the embodiments can be embodied and/or implemented at least in part as a machine configured to receive a computer-readable medium storing computer-readable instructions. The instructions can be executed by computer-executable components integrated with the application, applet, host, server, network, website, communication service, communication interface, hardware/firmware/software elements of a user computer or mobile computing device, or any suitable combination thereof. Other systems and methods of the embodiments can be embodied and/or implemented at least in part as a machine configured to receive a computer-readable medium storing computer-readable instructions. The instructions can be executed by computer-executable components integrated by computer-ex-

ecutable components integrated with apparatuses and networks of the type described above. The computer-readable medium can be stored on any suitable computer readable media such as RAMs, ROMs, flash memory, EEPROMs, optical devices (CD or DVD), hard drives, floppy drives, or any suitable device. The computer-executable component can be a processor, though any suitable dedicated hardware device can (alternatively or additionally) execute the instructions.

As a person skilled in the art will recognize from the previous detailed description and from the figures and claims, modifications and changes can be made to the embodiments of the invention without departing from the scope of this invention as defined in the following claims.

We claim:

1. A method for controlling a payment card comprising a magnetic stripe emulator, the method comprising:

at the payment card, wirelessly transmitting a first inquiry for a computing device affiliated with the payment card;

in response to receipt of a first wireless communication from the computing device following the first inquiry:

initiating a first timer for a first duration of time, and

enabling a function of the magnetic stripe emulator to emulate a payment method based on a magnetic sequence command corresponding to the payment method and stored on the payment card;

in response to expiration of the first timer:

initiating a second timer for a second duration of time, and

at the payment card, wirelessly transmitting a second inquiry for the computing device;

in response to expiration of the second timer prior to receipt of a second wireless communication from the computing device following the second inquiry, disabling the function of the magnetic stripe emulator.

2. The method of claim **1**, wherein wirelessly transmitting the first inquiry for the computing device comprises wirelessly transmitting the first inquiry in response to detecting an impact on a surface of the payment card, the impact exceeding a threshold magnitude.

3. The method of claim **1**, wherein enabling the function of the magnetic stripe emulator comprises transitioning into a first mode in response to receipt of the first wireless communication from the computing device; and wherein disabling the function of the magnetic stripe emulator comprises transitioning into a second mode in response to expiration of the second timer prior to receipt of a second wireless communication from the computing device following the second inquiry.

4. The method of claim **3**, further comprising:

in the second mode, wirelessly transmitting a third inquiry for the computing device; and

in response to receipt of a third wireless communication from the computing device following the third inquiry:

transitioning into the first mode,

initiating a fourth timer for the first duration of time, and

enabling the function of the magnetic stripe emulator.

5. The method of claim **4**, wherein disabling the function of the magnetic stripe emulator in response to expiration of the second timer comprises locking the payment card in the second mode; and wherein transitioning into the first mode in response to receipt of the third wireless communication following the third inquiry comprises unlocking the payment card in the first mode.

6. The method of claim **3**, further comprising, in the second mode:

receiving a series of inputs through a set of input regions on a surface of the payment card;

authenticating the series of inputs as a passcode; and

in response to authenticating the series of inputs as the passcode, enabling the function of the magnetic stripe emulator for a third duration of time.

7. The method of claim **1**, wherein disabling the function of the magnetic stripe emulator comprises maintaining a coil within the magnetic stripe emulator in an unpowered setting.

8. The method of claim **1**, further comprising receiving a selection for a first input region in a set of input regions on a surface of the payment card, correlating the selection for the first input region with a first payment method corresponding to a first magnetic stripe sequence command stored on the payment card; wherein enabling the function of the magnetic stripe emulator comprises powering a coil of the magnetic stripe emulator according to the first magnetic sequence command in response to detecting a card reader proximal the payment card.

9. The method of claim **8**, further comprising wirelessly receiving the first magnetic stripe sequence command from the computing device, wirelessly receiving a second magnetic stripe sequence command correspond to a second payment method from the computing device, and assigning the first payment method to the first input region and the second payment method to a second input region on the payment card according to a payment method rank received from the computing device.

10. The method of claim **1**, further comprising, in response to detecting a magnetic read head of a card reader adjacent the payment card prior to expiration of the first timer, driving a coil within the magnetic stripe emulator according to the magnetic sequence command based on a detected speed of the payment card relative to the magnetic read head.

11. The method of claim **10**, further comprising, in response to driving the coil within the magnetic stripe emulator according to the magnetic sequence command, disabling the function of the magnetic stripe emulator.

12. The method of claim **1**, further comprising, at the payment card, establishing a wireless connection with the computing device in response to receipt of the first wireless communication from the computing device; wherein wirelessly transmitting the second inquiry comprises wirelessly transmitting the second inquiry further in response to failure of the wireless connection.

13. The method of claim **1**, wherein initiating the second timer comprises initiating the second timer for the second duration of time shorter than the first duration.

14. The method of claim **1**, wherein initiating the first timer comprises initiating the first timer for the first duration of time corresponding to a location of the mobile computing device in wireless communication with the payment card.

15. A method for controlling a payment card comprising a magnetic stripe emulator, the method comprising:

at the payment card, wirelessly transmitting a first inquiry for a computing device affiliated with the payment card;

in response to receipt of a first wireless communication from the computing device following the first inquiry:

initiating a first timer for a first duration of time, and

enabling a function of the magnetic stripe emulator to emulate a magnetic stripe card based on a magnetic sequence command corresponding to the magnetic stripe card and stored on the payment card;

in response to expiration of the first timer, wirelessly transmitting a second inquiry for the computing device;

in response to receipt of a second wireless communication from the computing device following the second inquiry:

initiating a second timer for a second duration of time, and

preserving the function of the magnetic stripe emulator to emulate the magnetic stripe card;

at the payment card, wirelessly transmitting a third inquiry for the computing device in response to expiration of the second timer; and

in response to absence of a third wireless communication from the computing device responsive to the third inquiry, disabling the function of the magnetic stripe emulator.

16. The method of claim **15**, wherein wirelessly transmitting the first inquiry computing device comprises wirelessly transmitting the first inquiry for a unique wireless communication address associate with the computing device and stored in memory on the payment card.

17. The method of claim **15**, further comprising, in response to detecting a magnetic read head of a card reader adjacent the payment card prior to expiration of the first timer, driving a coil within the magnetic stripe emulator according to the magnetic sequence command based on a detected speed of the payment card relative to the magnetic read head.

18. The method of claim **15**, further comprising, in response to expiration of the second timer, initiating a third timer; wherein disabling the function of the magnetic stripe emulator comprises disabling the function of the magnetic stripe emulator in response to expiration of the third timer prior to receipt of a third wireless communication from the computing device; and further comprising:

in response to expiration of the third timer, wirelessly transmitting a fourth inquiry for the computing device;

in response to receipt of a third wireless communication from the computing device responsive to the fourth inquiry:

initiating a fourth timer for the first duration of time, and enabling the function of the magnetic stripe emulator.

19. The method of claim **18**, wherein initiating the third timer comprises initiating the third timer for the third duration of time shorter than the first duration.

20. The method of claim **15**, wherein enabling the function of the magnetic stripe emulator comprises arming a processor within the payment card to drive the magnetic stripe emulator according to the magnetic sequence command stored in memory on the payment card; and wherein disabling the function of the magnetic stripe emulator comprises maintaining a coil within the magnetic stripe emulator in an unpowered setting.

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